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SEISMOLOGY AND CABLES.

WE have before us a copy of the paper on "Sub-oceanic Changes," read last Friday week by Prof. John Milne, F.R.S., at the Royal Geographical Society. It deals with the subject with a directness and suggestiveness that cannot fail to make it appreciated by every physiographer and cable-engineer.

In formulating an opinion as to the causes operating in the fracture of submarine cables, the author calls attention to the instability of sea-bottoms in those critical regions between the abysmal level floors of oceans, and the coast lines of continents or islands. Admitting the tranquility of things at great ocean-depths, corresponding to the level plains of the Atlantic, and postulating only slow changes of level for continents in general, there remain for consideration the steep slopes that form the fringes between land and sea. It is in this critical region that cables are broken.

Fluvial sediments and talus are the results of wear and tear over comparatively large areas of land, but they are deposited over comparatively small areas of sea-bottom. Hence there is concentration of *débris*, resulting in submarine ridges, with steep and unstable slopes. This is the state of affairs at the critical regions bordering islands and continents. Prof. Milne suggests two causes that bring about changes of level in such sub-oceanic ridges. There are first the folding, thrusting, and crushing actions of the milder earthquakes, and secondly, the formation of unstable contours by sedimentation, awaiting some such "catastrophe" as seismic movement, facial sliding, basal crush, or submarine springs, to break them. In many cases submarine dislocation is a sliding effect, the result of overloading. On land the corresponding conditions are brought about by subterranean activities.

Some important generalisations are given as to the character of submarine districts where seismic disturbances are most usually to be observed. These are the regions most unsuitable for cables. Comparing districts where earthquakes of submarine origin are frequent, with those where they are practically unknown, we have to notice that, in the former, the land, as shown on the seaboard, usually consists of strata geologically new, with evidences of recent elevation; its average slope from the mountains in the interior, to beneath the ocean, is relatively steep. If slopes of considerable length are found extending beneath the ocean steeper than 1 in 35, submarine earthquakes, with accompanying landslips, may be expected. On the summit of these slopes, whether they terminate in a plateau or as a range of mountains, volcanic action is frequent. Earthquakes originate on the lower portions of the face and base of these declivities. Seismic strain, due to a tendency to further readjustment, is greatest where earthquake origins are most frequent. The home of the volcanoes is where rocks have been most deformed; that of the earthquake is at the base of steep sub-oceanic slopes, where most de-

formation is in progress. The forces producing this deformation are, first, the horizontal thrust; and, secondly, a factor dependent upon gravity. It may be concluded that distortions and displacements due to bending, thrusting, and crushing, are greater beneath the sea than they are upon continents or islands.

The theory of the causes that bring about sudden displacements generally takes cognisance of the fact that volcanoes occur most frequently at the fringes of continents and islands. They are numerous along the line of the Andes, and the great islands bordering the Pacific. Prof. Milne now points out that not only along the margins of coasts, but also in the deep sea, there are activities that culminate in these sudden displacements. Thus landslips beneath the sea, like those upon the land, occur at the faces of steep sub-oceanic slopes, and these may extend from the coast line for a distance of several miles. With sea-bottom gradients varying from 1 in 1 to 1 in 15, cables have suffered fracture.

In order to investigate the contours of sedimentary deposits, the author made experiments with sand falling through a small nozzle into an aquarium; but he points out that information deduced from these experiments is not strictly applicable to ocean deposits; and, we may observe, nature does not deposit sand through nozzles. The following conclusions are therefore given with some reservation. (1) Sediments deposited under the influence of currents, accumulate in slightly flatter forms than those of similar materials built up on land. (2) Peaks, edges, and corners of loose material, though fairly stable on land, are quite unstable beneath water, and they quickly become rounded. (3) A mound or bank when thus rounded is very stable, even under the influence of strong currents, but the unstable form may be speedily reproduced by accumulation of new sediments. It is therefore to be inferred that the upper portions of sub-oceanic deposits are at times unstable, facial sliding may be expected, and cables in the vicinity are more or less in danger.

Keeping well in view the causes that bring about sub-oceanic landslips, the author proceeds to a closer examination of cable fractures. Far out "on the great gray level plains of ooze where the shell-burred cables creep," there is comparative repose, but, as the critical region is approached, sections are found twisted, bent and crushed. Sometimes they are picked up coral-covered, and with all the evidence of having been suspended. Others show that fracture has been the result of abrasions; the ends of wires, at other times, indicate that fracture has been the result of tension. Needle-pointed ends suggest electrolytic action as a mode of destruction. But although cable interruption may occur in these several ways, the explanation most in accord with the facts attributes the mischief to sudden displacement of their bed, or to their burial by the slip of materials from some neighbouring slope, generally the result of earthquakes. Of twenty-nine recorded instances of cable fracture cited by Prof. Milne, sixteen have coincided in point of time with recorded earthquakes. Numerous other instances are given, together with the probable cause of fracture. Of 245 breaks, 87 occurred at times when instruments were in operation capable of recording unfelt earthquake effects; 58 of the 87 happened when Europe was agitated by these movements. In 10 cases the fractures were accompanied by volcanic disturbances that could be felt, and in two instances they caused destruction on neighbouring shores. It is reasonable to conclude that the records of unfelt earthquakes approximating in point of time with cable interruptions may indicate submarine geological changes; such displacements account for nearly all the fractures; inherent faults are comparatively rare. The number of breaks per N.M. per year in 10,891 N.Ms. of cable is 0·0023; this number corresponds to the coasts of Africa and South America; and is fairly representative. The foregoing results indicate that geological changes are more rapid beneath oceans than upon the land.

Cable engineers can congratulate themselves upon having had this matter so thoroughly investigated by so able and practical a man as Prof. Milne; it is greatly to be hoped that the Foreign Office will favourably consider the circular of the Seismological Committee of the B.A., with a view to establishing observatories for the proper recording of these earth tremors.

There are one or two small points in Prof. Milne's paper that might be looked to before it is finally printed. "The rate *per superficial unit* at which the land is being lowered" is a little difficult to comprehend. And "a barricade of post cards" extended to a point 450 miles of Tokio would have made "My Uncle Toby" whistle half-a-dozen bars of "Lillabullero." He would have said "fusilade." Moreover, the algebra has gone a little adrift. The wording of the second paragraph of Section II., especially the first part of it, is rather involved. And a "large but empty aquarium" is expressive but uncomfortable.

An Electro-chemical Rectifier.

Herr Charles Pollak, of Frankfort-on-Main, has made an ingenious application of what may be called the principle of the double acting air pump to convert alternating currents into pulsating direct currents. If the inlet and outlet openings of a double acting pump are connected together by a pipe, then the alternating motion of the piston will produce a continuous unidirectional current in the pipe circuit. This result is attained by the use of four non-return valves, two communicating with each end of the cylinder and opening in opposite directions. All that is required in order to apply the same principle to alternating electric currents is an arrangement which shall play the part of the non-return valve. This Herr Pollak has discovered in the electrolytic condenser. [*Elektro. Zeitschr.* June 24th, 1897, German patent, No. 92,564, 1896.] The condenser plates are of sheet aluminium formed in an alkaline solution. When one of the aluminium plates is replaced by a plate of lead, the cell has the peculiar property of allowing a current to pass in one direction only. The inventor states that these cells are applicable for E.M.Fs. up to 110 volts per cell. This non-return cell is applied in the rectifier in the following way. One cell is inserted in each side of a square made up of four conductors. To the corners of the square are connected four conductors, 1, 2, 3, and 4, of which 1 and 3 are connected to an alternator, and 2 and 4 to an apparatus using continuous current. The lead plates of two of the cells are turned towards the conductor 2, while the aluminium plates of the other two cells are turned to the conductor 4. The greatest practical objection to this ingenious idea appears to us to be the very low efficiency of electrolytic condensers.

THE GENERATION OF STEAM.

Two papers read before the Municipal Electrical Association by Mr. J. J. Steinitz, of West Ham, and Mr. J. F. C. Snell, of Sunderland, are interesting, and deserve notice, though they are by no means correct in every particular.

That by Mr. Steinitz appears to us the least correct in the number of its deductions and arguments. Mr. Steinitz expresses his surprise that cross tubes in the flues of Lancashire boilers are often omitted, because "even if they do not much increase the circulation, they strengthen the flue tube." Both his inferences are wrong. Cross tubes are proved by experiment not simply to "not much increase circulation," but to actually retard it, as one can very well see is likely to be the case. If used at all they ought all to slope the same way, namely, inwardly, towards the bottom centre line of the boiler. As to strength, a tube is not strengthened by putting cross tubes into it. The rings containing the cross tubes may be slightly stiffened, but this is doubtful. But what about the weakest part of the tube—the furnace part itself? No tubes are ever placed there. Mr. Steinitz would evidently strengthen a half-inch chain by adding an occasional three-quarter inch link in its length. Cross tubes add so little to the heating surface, so much to the difficulty of proper cleaning, are so efficient as extinguishers of flame, and therefore smoke producers, that there is no difficulty in understanding why experienced engineers condemn their use. We are next informed that one large maker of Lancashire boilers recently advised water tube boilers for pressures above 120 lbs. If there were any sound basis for this opinion, the Lancashire and other shell boilers had better retire at once, for there will be few more pressures less than 120 lbs. But it is not true. More probably the said large maker had no modern plate bending rolls, and did not possess a shell drilling machine. With good water, we are told that a Lancashire boiler will last 20 years without need to diminish its initial pressure. Twenty-five years is the figure, we believe, allowed by the Manchester Steam Users Association. Mr. Steinitz is under the impression that water tube boilers give the highest evaporative efficiency of all boilers except the Thorneycroft. We cannot imagine where he gets his information. Nor do we see how the floor space of water tube boilers is so small for the work done as the author seems to think. The marine boiler is spoken of as an unqualified success.

We quite agree with the author in demanding that feed water should be treated for hardness before it enters the boiler, and he refers to the use by Mr. Proctor, of Bristol, of a cream separator to deal with the oil in condensed steam. It is only by increasing the differential of gravity that fine particles of oil can be rapidly separated, and this, of course, is what the cream separator effects.

In speaking of mechanical stokers, the author is favourable to the sprinkling type rather than to the coking type of machine, and generally favourable to mechanical stoking as being economical. As he does not yet possess a station, he will probably not yet have received any complaints from his neighbours about the emission of flue dust from the chimney. We trust, when he is fully at work, he will let the world know if these complaints are well founded, or otherwise: we have contradictory reports, and it would be desirable to have the matter decided. As an efficient machine, capable of raising a lot of steam, and of being, to some extent, forced, the sprinkling stoker deserves his praise. It has, in addition the advantage of producing smoke very continuously, but thinly, so that a huge aggregate of smoke per day escapes notice. The same amount condensed into what we may term hand firing intervals would bring a summons from the smoke inspector. The trouble with coking stokers lies in the burning through of the fire and excessive admission of air to chill the boiler. It is difficult to see how a remedy can be found for this, or how such a stoker can be forced. Were it safe to do so, the sprinkler would be cured of its worst fault by damping the fuel with petroleum to cause aggregation of the dust, or any inflammable liquid would serve the purpose. Water will do, but may cause loss by its evaporation.

Mr. Steinitz limits an economiser to where the boiler gases exceed 400° in temperature, and states their economy to be as a rule 10 to 15 per cent. He very properly condemns their being fed with cold water, because this causes rapid external corrosion. He might have added that it is the lower sixth part of the pipes which corrodes, because experience teaches that only this extent of pipe is as a rule attacked. In one-sixth the length of the pipe the water is heated to a point where it will not cause condensation of flue gas acids upon the pipe surface. The remedies for this are, we should say (*a*) heat the feed by steam to the extent necessary before it enters the economiser, either by some feed coil or other means. Our own way would be to draw water from the hot well and pass it through a coil in the exhaust pipe, thereby aiding the condenser. (*b*) Cut out one-sixth of the economiser and place this in series. By this means one-sixth of the number of pipes will be wholly corroded instead of a sixth part of all the pipes. This method would leave the remaining five-sixths untouched. In a set of 300 pipes where all the pipes would be rotted through at the base in say seven years, we could first pass the feed through 50 pipes, and then on to the remaining 250. The 50 would still last the 7 years and the 250 would remain unharmed. At one of the large plate-glass works in St. Helens they had a bye pass and took part of the heated feed back again to the feed pump and so warmed the feed above the critical point. Corrosion of economiser pipes soon stops the proper action of the scrapers, and this alone is enough to render it desirable to stop the corrosion.

For variable load forced draught is recommended for topping the peaks even if at a less efficiency for the short time. It would certainly be cheaper to do this than to have so much extra boiler volume going all the time in order to cope with a momentary peak. The author seems to favour the closed stokehold variety of forced draught, wherein we think he is in the wrong, for land purposes, not perhaps in principle but for constructive reasons. One thing is certain. If Mr. Steinitz is not altogether correct in some of his views on steam generation he will lose no chance of learning. Mr. Snell's paper deals rather with types of boiler than modes of work. As basis he takes 1,000 lbs. for evaporation. Of the Lancashire boiler, he says the pressures are 120 lbs. to 150 lbs., but 200 lbs. is common, which seems to answer Mr. Steinitz somewhat. To evaporate the 1,000 lbs. requires 69 square feet of floor space, and £76 value for boiler with economiser, and £99 if without economiser, which he correctly considers is necessary to complete a Lancashire boiler. The economiser will reduce to 300°, the gases leaving the boiler at 600°. He is generally favourable to the type, were it not slow to start, and he advises forced circulation to get the bottom of the boiler hot. It is the cheapest boiler to clean, and he has found it cost only £9 annually to clean a 30-foot × 7½-foot boiler. It can burn 30 lbs. coal per square foot hour, and will last, according to Hutton, 33 years. Of the water tube boiler the 1,000 lbs. basis requires only 34·4 square feet of floor, and costs £96; but the boiler has small steam space, and a fire-brick interior lining is costly to repair. It is costly to clean, but a quick steamer, and requires more fuel to keep up steam when at rest than a Lancashire boiler, which means if properly reasoned out, that when working there must be the same extra loss going on. It will send off its flue gases at 250°, if not fired hard. This is Mr. Snell's figure, and if true, would, as he says, imply a high efficiency or an immense leakage of air. We leave Mr. Snell to find this out, contenting ourselves by asking him at what pressure the water inside a boiler has a temperature of 250°, and how such water is evaporated by the flue gases. Evidently Mr. Snell only works his boilers at something under 15 lbs. gauge pressure. There is more uncertainty noticeable about the exit gas temperature of water tube boilers than we should expect to see from men who need only turn to any pocket-book for a table of temperatures and pressures. It seems that in a Snell boiler heat will pass from a cold to a hot body, for we must really credit him with more than 15 lbs. boiler pressure. The cost of cleaning is £24 12s. per annum, and the life, as per Hutton, 15 years.

Of the economic boiler, we are told that its floor space is 34·4 feet, and its cost £94 per 1,000 lbs. evaporated; but that it requires soft water, and costs £20 per year to clean with fairly hard water.

Of the marine boiler the space is 25 feet only, and the cost £100, while cleaning costs £18.

While we agree that boilers should be tested and inspected during construction, we fail to see the need of an evaporative test being made of each boiler. Of what possible good would a test of a Lancashire boiler 30 feet × 8 feet be to anyone? The test would be good or poor according to weather, fuel, or man. As well insist on measuring every nail in a keg of 2 inch wire nails. Mr. Snell's figure for water softening plant, which he recommends, is about 0·18 lb. per kilowatt installed.

Perhaps a better figure to use is, in pounds of cost, one-tenth of the number of gallons per hour to be softened. On the whole Mr. Snell's paper is fair, but he is too much trammelled by the conventionalities that have been set up for the central station engineer. He accepts as gospel much of the pabulum that has been offered him, and passes it on undigested to his hearers.

AUTOMATIC INTERRUPTER FOR OPENING AND CLOSING FROM A DISTANCE THE CIRCUITS TRAVERSED BY HIGH TENSION CURRENTS.

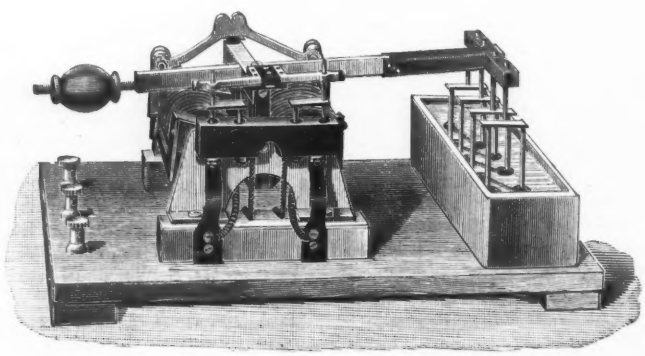
It has up to the present, says A. Z. in *L'Industrie Electrique*, been impossible to entrust the manipulation of the interrupters placed upon the primary circuit of alternating current distributions, either to the consumers or to the apparatus worked by this distribution, engines, lifts, intermittent lighting apparatus, &c.

This impossibility no longer exists, thanks to the automatic interrupter constructed by the Compagnie Française d'appareillage électrique (formerly Grivolas, Sage & Grillet) which we are about to describe.

This apparatus is worked by a feeble current furnished by a local battery. It consists, as shown in the figure, of two electro-magnets which actuate a lever.

This lever bears, at one of its extremities, a series of metal rods, tipped with platinum which dip into a series of cups of mercury when the lever inclines to this side; the other extremity of the lever is provided with a counterpoise with lock screws for regulating the apparatus.

When the battery current is sent into one of the electro-magnets the armature is attracted and acts upon the beam of this balance which is inclined in one direction, to the right for instance, and the metal rods dip into the cups of mercury.



These mercury cups are formed of a block of porcelain in which are holes insulated from one another and filled with mercury. As the first and last of these holes become connected, one with one of the poles of the primary current, and the other with one of the terminals of the transformer, every time the rods dip into these cups, the primary current will be closed on the transformer. When, on the contrary, the battery current is sent into the opposite electro-magnet, the armature being attracted in a contrary direction, the lever inclines to the left, the rods are lifted out of the cups of mercury and the primary current is interrupted.

Two catches are worked alternately by the same electro-magnets that move the lever. These catches under the action of the electro-magnets release the lever so as to leave it free at the moment when it is required to incline to the right or left, and afterwards hold it, when it has reached the end of its movement, thus preventing the possibility of its returning to its original position.

This arrangement ensures absolutely the good working of the apparatus.

Lastly, the current of the battery that works the electro-magnets is interrupted automatically after each oscillation of the lever in order to avoid the exhaustion of the battery and to allow of a service of longer duration.

Six Leclanché elements are sufficient for the good working of the system.

This apparatus has been constructed specially for electric lifts, which are being more extensively used for economical reasons. It enables the primary current to be closed upon the transformers only during the time really required for their use.

The manipulation of the lift cable closes the circuit of the battery on one of the electro-magnets of the apparatus; and the primary current being immediately established, the lift ascends; the second manipulation of the lift cable again closes the circuit of the battery on the opposite electro-magnet which this time, causing the lever of the interrupter to turn in the opposite direction, breaks the primary current and stops the lift.

As this apparatus interrupts high tension currents automatically and from a distance by cutting out the transformers, it will render great service wherever this current is only employed at certain times, or as in the case of an engine or of electric lighting during certain hours or during the evening only, as it will avoid the continual expense of the transformers working without any load.

By adding to this apparatus some clockwork mechanism designed for the purpose, it would be possible to arrange that the primary current should only be connected with the transformers during the hours of lighting, and thus to save all the energy expended uselessly in the transformers during the day.

ELECTRIC POWER PLANT EFFICIENCIES.

A paper read before the American Society of Mechanical Engineers by Mr. W. S. Aldrich on "Rating Electric Power Plants upon the Heat Unit Standard," forms the text of an article in the June issue of our contemporary the *Street Railway Journal*.

Both the paper and the article contain lamentations on the lack of a satisfactory standard of comparison for the performances of various power plants.

From the paper we learn that the standard of comparison at present in use is "kilowatts per pound of coal or per gallon of oil" (fuel). The word "kilowatts" probably standing for "kilowatt-hours."

Such a rough and ready standard is obviously defective even for commercial purposes, particularly where the plant to be tested consists of an engine and dynamo whose maker had nothing whatever to do with the boiler and steam pipes.

The standard proposed by the author and blessed by our contemporary is "the output measured at the switchboard and expressed in kilowatts per million British thermal units supplied to the steam used in the whole plant." This standard has the advantage of sounding much more scientific than "pounds of coal per unit." It is, moreover, not so easily understanded of the people, which is possibly also a further advantage, but otherwise it appears to possess all the crudities of its uncultured progenitor.

This new standard as described would, in our opinion, be much more usefully employed as a test of the skill of the engineer who designed the station, than of the efficiency of particular portions of the plant.

At the outset, the standardiser is called on to determine the number of "thermal units supplied to the steam used in

the whole plant," but this, unfortunately, he can only do approximately. He may commence by ascertaining how many thermal units the coal used ought to have produced, or he may calculate how many units the feed water ought to have taken up; but in neither case can he ascertain how many were produced or taken up.

Taken as a test of the total efficiency of a power station, it is more cumbersome and less conclusive than the old-fashioned standard, and it has the further disadvantage of omitting the boiler performance from the account. If it be designed simply as a test of the generating units, then it fails most lamentably. Suppose, for example, that an engine and dynamo have been supplied under contract to give at full power 1 kilowatt-hour for the expenditure of 30,000 British thermal units, and that the said engine and dynamo are built into a station containing eight similar sets—then, if it be tested singly it has to carry the thermal losses due to radiation and leakage in pipes, which ought to be spread over the other eight sets. Worse than this, it has to act as drain for the whole ring main, thereby reducing the thermal efficiency of the engine.

The late Mr. Willans held very strong views as to the deleterious effect of water in the cylinder, and in his paper on "Non-condensing steam engine trials," he expressed the view that initial condensation was largely due to the presence of water; this view did not at the time meet with much favour, but its accuracy has been most strikingly confirmed since. For instance, Prof. Kennedy informed the Institution of Mechanical Engineers on April 29th, 1896, that a Willans engine which, when tested at Thames Ditton (with a short steam pipe) took 24·2 lbs. of water per E.H.P. hour, when erected at the Edinburgh station took 31·3 lbs. per E.H.P.

Again, in Mr. Patchell's paper read the same evening, the consumption of saturated steam of a Willans engine working slightly under full load was given as 42·1 lbs. per E.H.P. hour; as this engine had been recently thoroughly overhauled, there can be no doubt that its excessive consumption was due to wet steam. Indeed, when tested again in October with 7° superheat, it only took 39·7 lbs. per E.H.P. Of course it ought to have done much better, say, 25 or 26 lbs. per E.H.P., but Mr. Patchell thought that in the four months' use since June, the valve and piston rings had become slackened.

Both of these instances prove that it is useless to make tests of engine efficiencies on a ring main, and that until we arrange one steam pipe to one engine we shall never be able to emulate the economical working of a cotton mill engine.

Assuming, for the moment, that facilities exist for testing an engine with saturated steam free from unevaporated water, then our English method of stating the result in pounds of steam (at a given pressure) per H.P. leaves very little to be desired; it includes the thermal unit standard and also the factor for pressure, which is usually controlled by the purchaser. With superheated steam the pure thermal unit standard would probably be more convenient.

Look at this question as we may, the fact remains that whether the standard of measurement be pounds of coal, pounds of steam or British thermal units, there is very little probability of our being able to dispense with Prof. Kennedy's comprehensive though cumbersome method of tabulating the results of a test in balance-sheet form, whereby each section of the plant is debited with its own losses, so far as they can be separately ascertained.

SHOREDITCH MUNICIPAL ELECTRICITY WORKS.

More than usual interest attaches to the electricity works which were opened with much *éclat* at Shoreditch on Monday last. It is, perhaps, to be regretted that the electrical side of the undertaking was not in a more complete state, but that portion of the undertaking which is exciting the keenest interest—namely, the dust-destructing plant—was in working order, and certainly may be said to have completely demonstrated the fact that it is possible to raise high pressure steam by the burning of town's refuse. This would not be a fitting place to discuss the policy of combining electricity with dust destructor works, but it will be generally admitted that such combinations have been hitherto carried out in the tentative manner inseparably associated with experiments. The electrical scheme forms part of a larger one, embracing Public Baths and Washhouses, Public Library, Museum, and Technical Schools; but when it is said that the central station is to be worked entirely by steam supplied from destructor cells capable of destroying all the household refuse of Shoreditch, it will be seen that the scale of the operations is sufficiently large to determine once for all the economy of combining dust and electricity. It is not necessary to say much about the history of the Shoreditch lighting scheme; suffice to say that there has been considerable striving in the past on the part of companies to secure lighting orders, and in order to keep powers in their own hands, the Vestry were compelled to proceed in the matter, and they did so. Shoreditch has a large area, and an equivalent population. It is also provided with 300 public-houses, numerous manufactories and warehouses, and, altogether, is considered a splendid field for the sale of electric light and power.

We do not propose at the present moment to lay before our readers a detailed account of the system of lighting at Shoreditch; we shall simply present the main features of the scheme, and give the results of a closer examination when the works are completed.

Dealing first with the most novel features of the scheme, those relating to the use of the dust destructors, we may say that the destructor house is 80 feet square, and contains 12 cells, each having 25 square feet grate area and six water tube boilers each, with 1,300 square feet of heating surface. What makes the destructors of especial interest is the use of Halpin's thermal storage system, and the substitution of electric lifts and motor cars for revising and distributing refuse throughout the cells, in place of the more usual inclined road and tipping platform. The boilers and thermal storage vessel (which is 35 feet long, and 8 feet diameter) are designed to work at a pressure of 200 lbs. per square inch, and are supplied with duplicate fittings throughout, to guard against breakdown. There are three motor-driven fans, calculated to deliver each 8,000 cubic feet of air per minute. The chimney is 150 feet high, and 7 feet internal diameter at the top, jacketed with firebrick throughout, and surrounded at the base with a centrifugal dust separating chamber.

The whole of the dust destructor, steam storage, and boiler work, has been carried out by Messrs. Manlove, Alliott & Co.

The gases from the cells pass out of each cell at the front, thence through the boiler tubes and out at the back of the boilers into either of the two main flues leading to the settling chambers and chimney.

Whenever required each boiler may be shut off, by means of dampers, entirely free from each or both, of its adjacent cells, and may also be fired at all times independently with coal or any other suitable fuel. Again, the cells may be worked independently of the boilers, but in this latter contingency the gases pass out from the cells at the back and not at the front. Owing to this arrangement, the cells may be repaired independently of the boilers, and the boilers may be repaired independently of the cells, moreover, in the event of refuse not being collected or being deficient from any cause whatsoever, steam may still be raised in the same manner as is adopted in any other electric lighting boiler house, viz.: by means of coal.

The cells themselves are charged with refuse by means of Boulnois & Brodie's patent charging trucks. This arrangement is novel as arranged at Shoreditch, although the principle has been adopted in many other district stations.

It is said to be possible for one man to keep the whole of the twelve cells charged at regular intervals, and moreover the refuse is never left to ferment or heat on hot brickwork or ironwork. It is always kept cool and thoroughly well ventilated by means of artificial draught provided by the fans.

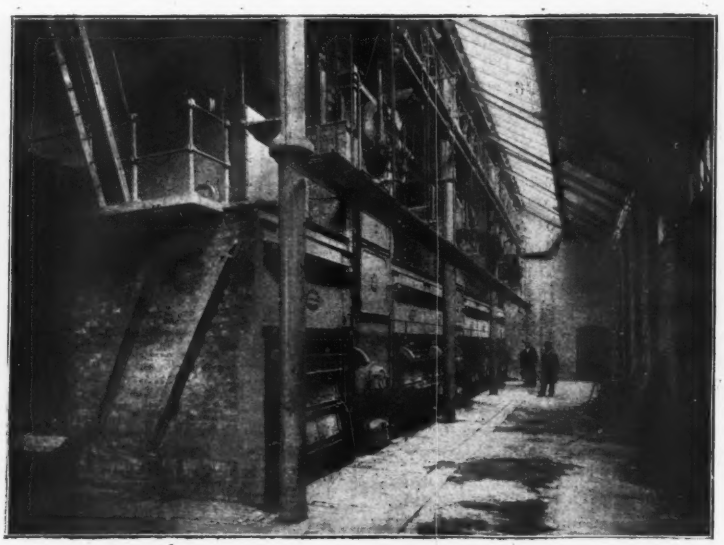
Steam will be generated at all hours during the twenty-four, owing to the necessity of burning refuse continuously, and the working conditions are therefore essentially different from those prevailing in the ordinary coal-fired boiler house.

With the arrangements at Shoreditch, during the day time, steam generated in the boilers is passed into a thermal storage cylinder, where it is mixed with a small quantity of cold water from the feed pumps, the proportions being such that when the evening approaches the cylinder is full of water at the temperature and pressure of the steam required by the engines. The cylinder is then shut off from the feed

pumps and connected to the boilers, which in their turn are connected direct to the engines, hence, when the boilers require feed water, they are supplied with it from the cylinder at such a temperature that the fuel that is then being burnt has merely to furnish to the water in the boilers the heat sufficient to overcome the latent heat of evaporation at the required pressure. The result of this arrangement is that the boilers are able to evaporate about one-third more steam than they would be able to evaporate were they connected directly with the water mains, and, moreover, gases can be sent away from the boiler at such a low temperature that they would be useless for the purposes of even an economiser.

It is anticipated that the most efficient rate of working the destructor will be found to lie between 8 and 12 tons per cell per diem. The combined arrangement of cells and boilers is designed so that when 10 cells and five boilers are at work, the average evaporation per hour from refuse only will about equal the average quantity of steam required by the engines throughout the whole of the 24 hours.

By the addition of complete steam storage, the station as erected, in the first instance, could probably be run without the use of coal at all, but with feed storage only it is contemplated that a certain amount of coal will be burnt from the commencement. No doubt as the system of feed storage is shown to be successful, its extension to steam storage will follow.



Destructor Cells and Boilers.

The system of lighting is that known as the Oxford, the generating station being near one portion of the low tension network; low tension steam plant is also installed in the generating station as well as the high tension continuous current plant for feeding the motor transformer sub-station. The plants at present installed in the generating station consists of three E.C.C generators coupled to Willans's three-crank engines, each set having an output of 160 kilowatts at about 1,100 volts; and three E.C.C. low tension dynamos coupled to Willans's three-crank engines, each set having an output of 70 kilowatts at 165 volts. The speed of the larger sets is 350 revolutions per minute, and the speed of the smaller sets 460 revolutions per minute.

The Willans engines of both sizes have been specially arranged with automatic expansion gear, so that economical results and good governing are obtained when working at any pressure within the wide range of 200 lbs. to 120 lbs. to the square inch—this range of pressure being necessary in order to enable the thermal storage system before referred to, to be utilised in connection with the scheme.

The armatures of the dynamos are of the drum type, with Eickmeyer coil winding.

There is also installed in the generating station a volt-raising transformer capable of adding 75 volts to a current of 200 amperes. This transformer is used for adding the necessary volts to completely charge the set of accumulators.

A motor generator is likewise erected in the generating station, which is a variable ratio machine. This motor generator has an output on either side of 60 kilowatts, and it is used to enable either high tension current to be produced from the low tension generators, or low tension current to be produced from the high tension generators. By this means, during light load times, when it may be economical only to run one set either a high or low tension generator, current can still be produced of the other character.

The main switchboards are divided into three sections, namely—high-tension board, low-tension board, and arc-light board, each board being designed to permit of future extensions. We shall refer in a subsequent issue to the instruments and their method of working.

The public lighting as at present arranged for, consists of 57 standards supporting arc lamps replaced by incandescent lamps after midnight, and 36 incandescent lamps in bye-streets burning all night.

The system of using arc lamps burning until midnight only, and each arc lamp replaced after midnight with two 32 candle-power incandescent lamps, was originally recommended by the same engineers at Portsmouth; and the success it has met with there induced the Vestry of Shoreditch to adopt the same method.

Owing to the economy effected in the consumption of current between midnight and dawn, the arc lamps will be of a rather larger size than those generally used, namely, 12½ amperes at 45 volts.

These lamps are arranged in circuits of 19 in each series running off the high tension bus bars at a difference of potential of 1,000 volts.

The standards supporting the arc lamps are also provided with two brackets supporting the two 32 candle-power incandescent lamps referred to.

Each lamp-post is fitted up with a cutting-in and cutting-out switch, and with one of Messrs. Glover and Co.'s (Edmund's) patent automatic switches for controlling the lighting of the incandescent lamps, which have been recently described in these columns.

The arc lamps are of the Brockie-Pell type, double carbons, by Johnson & Phillips; as is also the ornamental carrier carrying the lamp. The lamp columns were supplied by Messrs. Walter Macfarlane & Co., of Glasgow.

As previously mentioned, the system of distribution is that known as the "Oxford" system, and the Vestry have arranged for the preparation of three sub-stations to start with in various parts of the parish. Of these, one, the principal sub-station at the junction of Curtain Road and Great Eastern Street, is already finished and in operation. It consists of an underground room 22 feet 6½ inches by 17 feet, which has been constructed underneath a road refuge, from which access is had to the sub-station by a flight of stairs.

In this sub-station are at present installed three motor transformers of the E.C.C. type with their automatic switches as hereafter described.

The other two sub-stations are cottages which have been bought by the Vestry, and the basements of which will be fitted up to take similar motor generators, the upper parts being let to the employés at the generating station as residences.

Each of the motor generators has an output on its secondary side of 400 amperes at a maximum electromotive force of 165 volts, receiving its primary current at an electromotive force varying from 1,000 to 1,100.

These machines consist of a single field magnet with a double wound armature, having a fixed ratio between the primary and secondary windings of 1,000 to 150.

The armatures run at a speed of 450 revolutions per

minute, and as in the case of the generators, the high tension windings of the armatures are of Eickmeyer form.

A special form of automatic lubrication has been provided to enable the machines to run for long periods without any attention whatever. To meet the objection of an excessive current necessary at starting, an extra winding has been provided on the fields of the motor transformers, which remains in series with the incoming current to the motor transformer from the feeder until the shunt begins to pick up, and the electromotive force of the primary side of the transformer has risen to a sufficient value, when the extra winding is short-circuited. This is accomplished by an ingenious form of switch, moved by an armature operated by the stray field of the motor transformer magnets themselves, and it is so arranged that once the motor transformer has been shut down, the extra winding is again placed in series with the feeder, so as to be ready for the next occasion on which the transformer is to be started.

The conductors employed for the distribution of the current through the parish have been provided by the British Insulated Wire Company and Messrs. Walter T. Glover and Co., and consist partially of vulcanised rubber cables and partially of paper cables, lead covered. It being considered undesirable in streets with a large amount of traffic over them, such as those in Shoreditch, that a burying-in system should be used, involving as it does the taking up of the roads when any repairs have to be effected, it was decided to use a drawing-in system, and earthenware conduits, made by Messrs. Doulton & Co., have been used throughout. These conduits are both two and three way, and each way is about 4 inches square. They are arranged so that the lid covering one duct, *i.e.*, that from which the house services will be made, is removable and replaceable by a second lid, having a pipe connection formed on it much in the same manner as in the earthenware conduits made by the same firm for Portsmouth, the other one or two ducts being made without the removable lids, as but infrequent connections will have to be made to the mains lying in these ducts.

Tipping Platform and Thermal Storage Cylinder.

There are three different types of conductors used in the distribution system, namely, the high tension concentric feeders, low tension distribution wires, and high tension twin-twisted arc light conductors; and each of these types of conductors is drawn into separate ducts.

There are also pilot wires and telephone wires, which are drawn into the ducts containing the low tension cables.

The system of low pressure distribution adopted is the two-wire system, in order to avoid the complications which would otherwise arise in the use of a three-wire system in automatically connecting the secondary sides of the motor transformers to the low tension network.

At constant intervals along the run of the conduits are drawing-in boxes of brickwork fitted with the British Insulated Wire Company's patent ventilated cover, designed to prevent accumulation of gas within the conduits.

The British Insulated Wire Company have provided and laid all the conduits above referred to, and drawing-in boxes, the concentric high tension feeders, the twisted arc light conductors, and a portion of the low tension distribution net-work.

Messrs. Glover & Co. have supplied a large quantity of vulcanised rubber-covered insulated cables for the low tension distribution network, about 20 miles of different sizes being drawn into the conduits. These cables are of the type this firm have supplied so largely for central station work.

They have also supplied special disconnecting boxes to join up their cables in the manner described above, and to enable them to be readily disconnected for testing and other purposes without disturbance to the general system of supply. They have also supplied the combined telegraph and telephone cables which run between the generating station and the sub-stations.

The steam pipes, exhaust mains, together with the pumps, and water tank and other ironwork, have all been provided and erected by the Thames Ironworks and Shipbuilding Company. In this installation the steam pipe design was a very important matter, owing to the high steam pressures at which the installation will be working, namely, 200 lbs. to the square inch.

The whole of the steam service is carried completely in duplicate from boilers to the thermal storage vessel and to the separate engines in the engine house.

The battery of accumulators has been provided and erected by Messrs. Pritchetts & Gold in the battery house constructed for that purpose. The battery is capable of discharging at a rate of 170 amperes for 6 hours at least, and of maintaining a minimum electromotive force of 165 volts throughout the discharge. It is also to be capable of being discharged without injury to it at much higher rates, the maximum being 350 amperes.

The capacity of the battery for a higher discharge rate than the normal being 272 amperes for three hours; the minimum electromotive force of 165 volts being maintained in all cases.

The whole of the mechanical work has been put up directly under the supervision of the Vestry's chief electrical engineer, Mr. Charles Newton Russell, who has assisted Messrs. Kincaid, Waller & Manville in that capacity, and the supervision of the laying of a considerable portion of the mains was carried out under Mr. R. F. Ferguson.

The system of charging adopted for current for lighting purposes is the Wright demand indicator system—6d. per unit being charged for an average daily use for two hours of each lamp demanded through each half-year, and 4d. per unit for the electricity consumed beyond that average two hours consumption.

In addition, there are two rates of charging for current used for motive power purposes, namely, 3d. per unit for current which may be demanded at all times of the day and night, and 2d. per unit for current that may be demanded during the hours of daylight.

The second charge was adopted in order to encourage that class of consumers who would consent not to use their motors during the time of heavy lighting.

The opening ceremony took place on Monday last, when, in the presence of a large assembly, Lord Kelvin formally turned on the current and declared the works ready to supply electricity to the public. Mr. E. J. Wakeling, chairman of the Shoreditch Vestry, presided over the proceedings, and there were present on the platform Prof. Stuart, M.P., Mr. J. Lowles, M.P., Mr. W. H. Preece, Prof. George Forbes, Mr. H. E. Kershaw, chairman of the Lighting Committee, and many others. Lord Kelvin said the undertaking was

worthy of the Victorian era as an example of the combination of scientific forethought, mechanical skill, and courage. Shoreditch was the pioneer vestry to utilise the heat from the dust crematories for raising steam, and this was only the beginning of what would be a much greater thing. In Shoreditch, electric motors would be substituted for gas engines, and much of the work would be done by energy obtained from dust and transmitted by electricity. Mr. H. E. Kershaw, the chairman of the Electric Lighting Committee, made a statement covering the scheme which had been inaugurated, and after various votes of thanks, the large company proceeded to inspect the plant.

In the evening a commemorative banquet was given at the Shoreditch Town Hall, Dr. W. J. Collins, chairman of the London County Council, presiding.

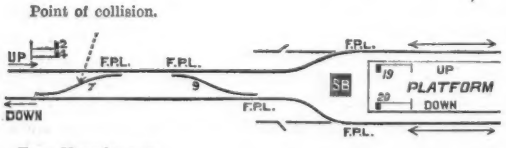
There were present many of the contractors and representatives from municipalities. After the toast of the "Queen" and that of "The Army and Navy" had been drunk, Dr. Collins, in proposing the toast of the evening, "Success to the Shoreditch Municipal Electricity and Dust Destruction Undertaking," said it was a mistake to suppose that the London County Council were opposed to the spread of municipal institutions in the metropolis. On the contrary, they thoroughly approved of such energetic bodies as the Shoreditch Vestry, and they wished the electric light and dust destructor works every success. The chairman of the Lighting Committee responded, and various other toasts, including the consulting electrical engineers and the contractors, were then duly honoured.

THE LIVERPOOL OVERHEAD RAILWAY ACCIDENT.

It may be interesting if we give some further particulars to those published in our issue of June 18th concerning the accident which occurred on this railway on April 15th, last. In this case as the 10 a.m. down train from Dingle was leaving the station it came into collision with a train of empty coaches from Herculaneum, the driver of which had allowed his train to run past the home signals and to foul the cross-over road leading from the up side of the island platform on to the down main line, through which the down train at that moment was passing. Three passengers complained of injuries, and the leading carriage of each train of two coaches was badly damaged, although both drivers escaped unhurt.

Lieut.-Col. H. A. Yorke, R.E., reporting to the Board of Trade on the collision, comes to the following conclusions:—

The circumstances leading up to this collision, as disclosed in the evidence, are as follows:—At 9.57 a.m. the cars forming the 10 a.m. train ex Dingle, were standing on the up platform line, and the down platform line was clear. At this time the empty carriage train was offered on the block instrument to signalman Orford at Dingle from Herculaneum, and was "accepted" at the same time. The manipulation of the block instrument for the purpose of accepting this train, locked No. 7 cross-over road (from the up platform to the down main),



and the down starting signal (No. 19) from the up platform line, so that it was not possible for Orford to lower this signal for the 10 a.m. train to start. In order to obtain a release from this lock, Orford made the road for the empty carriage train to run into the down platform, and lowered No. 4 up home-signal for it, and then without waiting for the train to arrive, he replaced this signal to danger, and restored the points to their normal position. These operations had the effect of releasing the lock on No. 7 points and No. 19 signal, and signalman Orford at once set the road and lowered the signal for the 10 a.m. train to start. In the meantime the empty carriage train was approaching the station, and when the driver of it came in sight of the home signals, they were, according to his statement, both at danger, so that although Orford had momentarily lowered one for the purpose explained, he had restored it to the danger position before driver Middlebrook saw it, and the latter was not therefore misled by what had been done. For some reason or other Middlebrook failed to stop his train at the home signals, with the result that he fouled No. 7 cross-over road at the moment that the 10 o'clock train was passing over it on its way to the down main line.

The right hand leading corners of the front cars of the two trains came into violent collision, and the bodies of the vehicles were smashed in, but fortunately the personal injuries were few, owing, no doubt, to one train being empty, and the other but lightly loaded. That the shock was one of considerable violence is sufficiently proved by the damage to the rolling stock, and by the fact that the empty train was driven backwards about 20 yards.

The primary cause of this serious occurence is to be found in signalman Orford's deliberate breach of the block rules and regulations, whereby he permitted the 10 o'clock train to start from the up platform at the time that the other train was approaching the station on the up line. His conduct is rendered the more reprehensible by the fact that the block instruments and the points, &c., were so interlocked as to guard against such a proceeding. This safeguard, however, had no deterrent effect upon Orford, as he at once set to work to evade it by going through the lever movements necessary for his purpose, doing in fact what would have been right if the empty carriage train had been permitted to run into the station. Moreover, the evidence makes it clear that this was by no means the first occasion on which the same thing had been done by him. It is manifestly useless for railway companies to incur expense in providing modern appliances for ensuring the safety of the travelling public, if a signalman is to be permitted with impunity to render all such safeguards nugatory, and to expose passengers to unnecessary danger.

As soon as Orford had accepted the empty train, it was his absolute duty to have allowed it to run into the station up to the down platform before he let the 10 o'clock train start. I regard his offence as exceedingly serious, and as one that should disqualify him in future for the responsible position of signalman. His only excuse is that he wanted to save time, and that if he had kept the 10 a.m. train back until the arrival of the empty train, the former would have been a minute late in starting. But such reasoning cannot for a moment be accepted as affording any justification whatever for this or similar misdeeds, for it is tantamount to recognising the suspension of block-working and the abolition of all precautions, whenever the normal regulations are likely to cause the least delay.

Richard Orford is not a regular signalman, his principal duties being those of station foreman, but he acts during a certain period of each day as relief signalman, and is thoroughly acquainted with all the routine and regulations of signalman's work. He had been six hours on duty in the station, and in the signal box for a quarter of an hour at the time of the collision.

Driver Thomas Middlebrook is also largely responsible for the occurence, inasmuch as he ran past the home signals which were at danger. Had he stopped his train in proper time the collision would not have occurred, but this fact does not in any way mitigate signalman Orford's offence. How it happened that Middlebrook did not stop when he should, it is impossible to say with certainty. Judging from the admitted irregularities in the working on this and previous mornings, it seems probable that Middlebrook expected that the 10 o'clock train would have left the station, and that the home signal to admit him into the platform would be lowered before he reached it. If this thought was in his mind he would naturally not be prepared to stop at the signal, but would expect to run direct into the station without a check. I have not any doubt that if he had been half a minute later that was what would have happened. If this suggestion is erroneous, it is difficult to account for his mistake. It is true he had not the use of the Westinghouse brake, but the gradient was against his train nearly the whole way from Herculaneum, the inclination being 1 in 100 for a furlong and 1 in 200 for two furlongs, and his hand brake operated blocks on six wheels of the train out of a total of 16. Moreover, the mechanism for switching the electric current on or off afforded complete control of the train. If, therefore, he intended to stop at the home signal, his failure to do so must be attributed to simple blundering and inefficiency. He had been on duty six hours.

THE DAYLIGHT WORK OF CENTRAL STATIONS.*

By THOMAS COMMERFORD MARTIN.

The development of the central station industry has been, in some respects, a disappointment. We have now had nearly 20 years of central station work in this country, and have witnessed an enormous growth in that period within the field of work covered by this organisation, but it is apparently as true to-day as when the association was formed, that the companies restrict themselves injuriously in their natural and logical advance by remaining mere lighting corporations. What would happen to us all if some new lighting medium came into vogue that deprived us of our illuminating business entirely? If we had to fall back on daylight work, might we not be better off?

That question suggests an extreme view of a rather impossible situation, the fact being that electricity, as an illuminant, gains steadily in public estimation, and has, at this moment, no new rival within speaking distance. But there is vital importance in the opinion of a local company as to whether it exists only to furnish light, or, on the other hand, to supply current for a variety of uses, new and old. My own opinion, modestly expressed, is that the intrinsic value of a company rises just in proportion as it gets off the lighting basis and builds itself up on that of current; just in proportion as it ceases to limit its activities by a moonlight schedule, and, like the British drum-beat, chases the sun with an insatiable, 24-hour desire for more territory and more trade.

A brief retrospect will not be out of place, if followed by a study of the present situation. It is as well not to go back further than 1886, for, although arc lighting is a full decade older than that, the industry 10 years ago took its great leap forward. A careful investigation shows that, in 1886, there were about 410 central stations in

* Read before the National Electric Light Association, Niagara Falls, N.Y., June, 1897.

this country. Of these, only 300 furnish available statistics, and it would appear that 226 of the companies were then only doing a night arc lighting business. It is safe to assume that all the companies which did not report were in the same category as the 226; so that, out of the 410 local companies, some 325 were doing business only between dusk and daylight, and were standing idle all the rest of the time. In other words, taking the year through, they were idle nearly two-thirds of the day, if the average running be taken at 3,000 hours a year.

To what degree have these conditions been improved in the ten years? This is an extremely difficult question to answer, but a few tentative figures may be acceptable as a basis for study and discussion. At the close of 1896 there were about 2,400 central stations in operation in this country, so that in 10 years the number had increased sixfold, a gain that is simply stupendous. Of these 2,400, however, 975 had, from the figures obtainable, no day circuits, and 220 others had only arc apparatus, so that 1,195 local companies, by their own admission, were limited to night work. The case is not, however, so encouraging as might be implied from these figures. Of the remaining 1,200 companies, only 327 report day circuits, and if it is safe to assume that half of the 900 companies and plants not giving these details were without day circuits it would appear that out of 2,400 local plants, at least 1,500 are limited to the night hours for their earning capacity. It must be noted, however, that nearly all the 900 companies not specifying day circuits are operating incandescent circuits very largely with the alternating current, so that the means for day operation are generally there under more or less favourable conditions.

It is obvious at once that an immense amount of capital and machinery is standing idle that might otherwise be productive of profit and dividends. Of the 1,200 companies confessing that they have no day circuits, only some 780 give their figures of capital and generating capacity in steam or water. It would appear that these plants, with a moderate capitalisation of $46,908,000, and with an engine and water-wheel capacity of 164,000 horse-power, are standing idle two-thirds of the day, and often a great deal longer.

Such figures are given broadly, and may be a little inaccurate in precise detail, but it is the mere fact that is so striking. It is obvious that these figures apply to the great bulk of small stations. And yet some of them are certainly not small. At least 65 or 70 of them have each a capacity of 500 horse-power and upwards, and several of them are legitimately capitalised at above a million dollars each. A company of such size 10 years ago was rare and exceptional, and would have been difficult to start, except on the general hypothesis that its business would include something beyond simple street illumination, with a little house lighting thrown in. It may be doubted whether capital of any magnitude could be enlisted to-day for a company that had no ideas beyond ordinary lighting work.

Without presenting this state of affairs as a cause for alarm, or intending to imply that a business is necessarily on a bad basis because limited to a few hours, it is not improper to inquire whether there is no chance for improvement. It cannot be said that local lighting companies have become notorious, like some gas companies, for paying large dividends; so that a slight amelioration of financial condition might not be objected to. Even trolley roads, running every hour of the day, find it difficult sometimes to make ends meet, but they have the satisfaction of a continuous use of their plant, and of knowing that they get all the business that offers. If there is any sufficient reason why a local lighting company should operate its generating machinery fewer hours than a trolley road, it has not made itself specially manifest except in one direction, which will be briefly referred to in a later paragraph. I believe every gas company is on a 24-hour basis of supply.

If the stationary motor work, whose claims I ventured to urge on this association 11 years ago, had been left to the local lighting companies, I fear it would not have made much headway. The 327 and other companies with day circuits do an enormous amount of power work, but a careful analysis of somewhat incomplete data would lead one to believe that the isolated plants are the real backbone of the electric power industry to-day. Why this should be so it is difficult to explain, except on the hypothesis that station current, when obtainable, often costs too much, and is generally not obtainable. It will, I trust, be understood that this paper is not offered in any wise as a criticism of central management, but simply a presentation of the puzzling facts that confront students of the situation. No one can know the inwardness of the problem so well as the central station manager himself, and no one can be more deeply interested than he in dealing with it wisely and well.

It might be said that, in a general survey, four new factors have presented themselves in the last ten years for the consideration and approval of the central station manager. These are motors, alternating current supply, storage batteries and electric heating. The alternating current is, for most stations, still restricted to night-work, and will be, probably, until more single-phase motors of successful character are on the market. This form of current has given such a tremendous stimulus to lighting that it deserves a wider range of usefulness, so that, in time, alternating current stations may compete with direct current stations as earners of dividend.

Allusion has already been made incidentally to motor work. What is possible in this direction is best judged from what the large stations do. Of course this is in some respects an erroneous guide, but in the same manner as great men are exemplars for those of less heroic bulk, so the large stations indicate the actual possibilities even for a lower plane of execution. The following are figures of a large western central station, showing the horse-power of motors connected to the circuits, and the percentage that the power consumption bears to the total output. The data come down to March 31st, 1897.

Low Tension.

Power connected April 24th, 1897	5,396 horse-power.
Power per cent. of the total output	23·1 per cent.

High Tension.

500-volt power connected April 24th, 1897 ...	1,566 horse-power.
Power per cent. of high-tension output	21·4 per cent.

All Systems.

Power connected April 24th, 1897	6,962 horse-power.
Power per cent. of the total switchboard output.	22·8 per cent.

Another example is to be found nearer home, in the work of the New York Edison Company. The motors to which that company supplied current from its distributing mains represented, on January 1st, 1896, a total installation of 11,640 horse-power. On January 1st, 1897, the motors connected were the equivalent of 15,930 horse-power, an increase of motors connected in a single year of 4,290 horse-power, or 36 per cent. This does not include an installation equivalent to 1,142 horse-power in motors to which current is supplied from the New York Edison stations during minimum hours, or for emergency and break-down connections. It will be seen that this brings the total horse-power in motors connected to the company's mains up to 17,072. The average size of these motors is from 3½ to 4 horse-power. Of the total motors connected it is estimated that about 5,000 horse-power equivalent is installed in connection with direct electric elevators and grip hoists.

In order that the idea should not go abroad that the big companies are monopolising the power business, but that it is open to all, I would mention that in Massachusetts, where there is only one large city, no fewer than eight companies out of 58 are supplying power from their arc circuits; 18 from incandescent circuits, and 29 from independent power circuits; the total being about 14,000 horse-power of motors on the circuits. The asking rate for kilowatt-hour averages about 20 cents, but runs down as low as 10 cents.

Turning next to storage batteries, it is not my intention to agitate old discussions, but simply to give a few figures, which would go to show that the batteries may do more than perform the Alpine feat of taking care of the peak of the load. There are at the present time in America—I blush to give the figures—only 15 central stations using batteries, with a total capacity of 25,000 horse-power hours output. Four other stations are being equipped. I hope devoutly that some future chronicler will be able to report that 1,500 stations are equipped with batteries, and that by their reservoir capacity they have answered in the affirmative the question whether their life was worth living. What batteries can do is best exemplified by the Duane Street station of the New York Edison Company, one of the biggest stations in the world, with an engine and generator capacity of 20,000 horse-power. The load during minimum hours, I am told by Mr. J. W. Lieb, jun., the general manager of the company, is such that it can be supplied in that period from the storage battery annex at the Bowling Green Building in the southern tip of the tongue of Manhattan Island; or from the storage battery plant at the Twelfth Street station, either alone or in conjunction with the current supplied from the Twenty-sixth Street station over the feeder tie lines. The supply of stored current from the batteries in the annex stations during the minimum hours enables the big Duane Street station to be shut down every night from 10.30 p.m. to 5 a.m.—nearly seven hours; and on Sunday the operation of the generating machinery at Duane Street is limited to one watch. I do not hold a brief for storage batteries, but in view of such facts it is hardly possible to do other than press their claims on the attention of central station managers.

A word in conclusion as to electric heating. When I hazarded, 11 years ago, before this body the expression of an opinion that motors ought to be pushed, it was regarded in many quarters as premature and visionary. From a conservative standpoint, it was so undoubtedly; but in everything success is not to be gauged by the point you are at. The real test is the way you are going; and if the tendency is right, all else that is desirable comes in due time. Now, in central station work, we can and must recognise but one tendency as the underlying and ultimate, namely, to increase the demand for current, and whatever does that is to be welcomed. To-day, electric heating, using that term in its generic sense to cover a variety of uses and purposes, stands just where electric power did 10 years ago. It is a parvenu, hardly admitted or recognised in good electrical society, but a "pushing young particle" that there is no snubbing or subduing. Much more recently than 10 years ago I was involved in a hot daily newspaper controversy in New York, with the object of proving that electric power had the ghost of a show; and now the advocates of electric heating are similarly put on their mettle. The main argument they have to contend against is an elaborate formulation of caloric theories and laws, all going to demonstrate the terrific loss and cost of heat units when delivered electrically to the man who wants them.

It is said that, with current sold on the basis of 20 cents a kilowatt hour, no business can be done in heating, and that, even if the price be cut in two, the inducement to possible customers is not great. If this were true, the matter of price of current might forbid the operation of a single fan motor from central stations. Making a rough calculation of 1 cent per hour for the ordinary fan motor, that is 10 cents a day for 10 hours steady running, or, say, $3 per month, or $36 a year. Allowing 12 such motors to the horse-power, the local companies are selling current to thousands of willing customers in the summer time at the rate of $130 a year per horse-power for a working day of only 10 hours. Other quotations can be made, showing the high price got readily for current in small quantities from purchasers who are perfectly satisfied with the bargain, and find it pays them also very handsomely in some element of comfort, pleasure, convenience, or even economy.

A test taken three years ago for 12 weeks, of current consumed in cooking a dinner of several dishes daily for a large number of persons, showed that for 97 persons, the current fell as low as 307 watt-hours per person. This would make 29,779 watt-hours, or, in round figures, 30 kilowatt-hours. At 10 cents per kilowatt-hour, that means an

expense of $3 per day, or say, $90 per month. It will, of course, be objected that, in a great many isolated plants, the current made on the spot does not cost more than 5 cents per kilowatt-hour, which would, in the building where the test was made, have brought the sum down to $45. I have tried to get some basis of comparison between this and an equal amount of work on a gas-stove or range for an equal number of persons, but this it is not easy to obtain. In one family I know, which consists of six persons, they have been cooking by gas for some 5 years; it costs, with gas at $1.25 per 1,000 cubic feet, on an average $5 to $6 per month, or from 16 to 20 cents per day, or about 3½ cents per head per day, if all are at home to every one of the three daily meals, which is far from being the case. If the same expense were averaged for the 97 persons for three meals daily, the outlay for gas in cooking would be between $90 and $100 per month, or about as much, if my figures are approximately right, as electricity would cost, if the current were supplied at 5 cents per kilowatt-hour. This is certainly a very encouraging showing for electricity, but we must not forget that central stations do not exhibit much anxiety to sell their current at 5 cents per kilowatt-hour, or even per horse-power-hour, and this is one reason why isolated plants have multiplied so tremendously in our cities. I might add, as one point of interest, that when the family I mention began to cook with gas, it bought a gas-range for $25, and paid $2 or $3 more to get it set. The range has worn out, and the family is now hiring a good one from the local gas company for $3 a year.

From these crude remarks of mine it will be seen how sadly tentative and experimental the art of electric cooking is for most of us; but is it not the duty of the local lighting companies to go into this matter, and see how far they can foster the new art by introducing the apparatus, and furnishing current for it cheaply? Even if the price falls short of $430 per horse-power per year, for 10 hours a day only, they should not feel discouraged.

I have spoken of cooking, but this is but one of many fields of usefulness for electric current heating supply. Our esteemed ex-president, Mr. J. I. Ayer, who has placed at my disposal much interesting data that I cannot produce here, for lack of time, gives me also a variety of information as to work that has lately fallen within his sphere of practical attention as representative of a large electric heating company. Their work includes a wide extent of shoemaking machinery, heated silk-finishing rolls, leather-working machinery, 387 curling-iron sets in the dressing rooms of the combined Waldorf and Astoria Hotels, in New York city, 72 sets in the Parker House, Boston, and apparatus in the Plankinton and Pfister Hotels, Milwaukee, as well as on the American Line steamers across the Atlantic. It would not be fair to omit the 14,000 car heaters installed, of one make alone, in the past year and a half. A blank-book manufacturer has had in use since 1894 from 35 to 40 electric glue pots, and Duryea & Co., the starch makers, are also users of electric heat apparatus. In Knabe & Co.'s piano factory, at Baltimore, 20 electric heaters have recently been placed; and there is a long list of clothing houses throughout the country that use electric irons. The same is true of vulcanisers for bicycle tyre agencies and factories, while irons in large numbers have been supplied to State asylums in Indiana, Michigan, Wisconsin, Illinois, New York, Massachusetts, Maine, and Maryland. It is simply impossible that all this apparatus should have been put in, unless it was economically or practically worth while; and this being so, is not the electric heat field one in which the local companies can now begin to work with advantage? Surely, here lies opportunity of the largest kind, to help the introduction of apparatus that must serve as a large customer for current at all seasons of the year.

The subjects I have brought up are, perhaps, inexhaustible, but in spite of the labour and tax on scant leisure involved in collating some of this data, I shall be repaid if in the smallest degree a stimulus is given to central station work and prosperity. I feel sure that whatever remarks I have made will be accepted in the spirit that prompts them—one of heartiest good wishes for the welfare of the typical comprehensive industry of the age—that of the electric central station.

MUNICIPAL ELECTRICAL ASSOCIATION—MANCHESTER CONVENTION, JUNE, 1897.

ABSTRACT OF PRESIDENTIAL ADDRESS BY C. H. WORDINGHAM, A.M.I.C.E., M.I.M.E. AND E.E.

NOT the least of the responsibilities of a President is the preparation of a presidential address, and in the present instance there are special difficulties which do not usually arise. It is the custom on such occasions either to bring forward an account of some special investigation, or to give an historical review of progress during some long period. The former method is not suitable to an Association of this kind, neither is the second available, for our Association can hardly be said to have a past, though I trust and believe that it will have a useful and perhaps brilliant future.

I purpose, therefore, confining my remarks to the present, and endeavouring to indicate some of the directions in which I think the Association may increase its sphere of usefulness.

First, as regards the Association itself, we have every reason to be proud of the progress which has been made. Our roll of membership already reaches 139. The objects of the Association appear now to be much better understood by the technical public than at first, and there seems every reason for congratulation that the Association was formed, and that the lines of its constitution were those decided upon. The Association is becoming recognised more and more each day as embodying the views of municipal authorities, and there can be no doubt that the meeting held in January last in connection with the question of fire insurance was productive of good results, and was very useful to all members.

Evidence has been forthcoming that the Association is already much appreciated by all classes of municipalities, not least by those smaller and more remote ones which find in it a means of keeping in touch with what is going on in the electrical world.

One Corporation, with the full approval of the contractor, has nominated the President of the Association as arbitrator in the event of disputes arising under certain contracts, and it seems probable that arbitration will be one important function of the Association in the future.

As will be seen from the programme, we have an immense amount of work to get through at this Convention. There is no doubt that in order to deal with all the subjects, we shall be obliged either to have one or more special meetings of the same character as that held in reference to fire insurance, or else to have two Conventions a year.

It will not perhaps be out of place if I remind those members who were present at the meeting when the Association was founded, of the very strong manner in which I urged that committees should be admitted to membership. To this the meeting finally assented, and I feel convinced that to this step is due in large measure, if not entirely, the success which has been attained. Without the presence of the gentlemen representing committees, the Association could have carried but little weight in any matters requiring united action. At the meeting referred to it will be remembered that I also urged that representatives of committees should be eligible as members of our Council. On this point, however, the meeting did not agree with me, but I foresaw that ultimately they must be admitted, for you cannot have two classes of members and only one of them represented on the Council. That this was strongly felt was evident at the last Convention, and I trust that at the present one the members will adopt the report of the Council on the subject.

The desirability of admitting assistant engineers as members in certain cases has been repeatedly urged upon the Council, and I have personally given the matter very anxious and careful consideration. It is extremely difficult to differentiate between assistants, and to decide what qualifications it is necessary to require them to possess to render them eligible for full membership. I must not enter into this matter further here, but I am hopeful it will be found at the business meeting that a satisfactory solution of the problem has been arrived at.

The various directions in which the Association might be of use were so ably set forth by our former President, Mr. Arthur Wright, and the field described was so extensive, that I think it is unnecessary for me to add much to it. There are, however, one or two suggestions which I may make. If carried out, they would, I believe, be of great use to members, and they might be initiated at once.

All those in charge of a station must have felt the difficulty of laying their hands at short notice on suitable men for various kinds of work. I am not alluding now to heads of departments, but to workmen, and those minor assistants such as draughtsmen, inspectors, and others of whom a plentiful supply exists, though not available for want of suitable organisation. I would suggest that the Association might keep a register of the various classes, and enter therein the names of suitable men seeking employment.

If this suggestion were carried out, there would be compiled a list of men of good character and of suitable attainments, and any member of the Association having a vacancy would be able to apply to the secretary, and would be practically certain of obtaining an efficient man. The convenience of this will be patent to everyone who has charge of a station, and I feel sure that such an organisation would be of immense practical service.

It frequently happens that as stations extend their operations, the plant which was best suited to them in their early days becomes too small to be of any practical utility, and it becomes expedient to dispose of this plant and substitute larger generators in its place. The old plant has probably been maintained in a condition practically as good as when it was new. In some senses it is even better, inasmuch as it is well tried, and has attained, so to speak, a stable condition. Now, this plant would be in all respects suitable for a station just starting, and might with great advantage be purchased instead of new, if it could be known that it was available. If, then, the Association could step in, as in the case of employers and employed, and bring together sellers and purchasers by means of a register of such plant, the interests of all would be served, and considerable advantage to members would ensue.

I look forward to the Association later on being in a position to make arrangements for the practical testing and stamping of electrical fittings and apparatus, for I feel convinced that only by some such means will the smaller towns be able to secure good work being done on their circuits. If a model set of general rules can be issued by the Association with the approval of the Board of Trade, and if it can certify that certain apparatus is of satisfactory quality and efficient, the question of safe and cheap wiring will be greatly simplified.

The question of the status of municipal engineers is one greatly concerning members of this Association, and it is a matter for satisfaction to observe that municipal authorities are at length beginning to recognise the importance of the duties discharged by their electrical engineers. At the beginning of the enterprise, the salaries offered and paid were such as could not possibly secure, at any rate for any length of time, the services of competent engineers. Such engineers as did accept the positions, in all probability did so solely with a view to securing experience, and a corporation is apt to find that salaries paid in experience instead of cash are extremely high. It should be manifest to any person who will consider the subject that the wise and economical expenditure of large sums of money on so highly technical a subject as electric supply—a subject which requires long years of close application and expensive study, cannot

be secured by the employment of men at a salary less than that of an ordinary clerk, or even of a common workman. A few towns, however, which it is unnecessary to particularise, have to their credit set the example of the payment of salaries more nearly adequate to the services required, and in time there can be little doubt that all towns will have to follow suit; some learning wisdom by bitter experience, others copying the example set them. In the case of small towns, it appears to me that it will be impossible for the amounts necessary to secure proper men to be paid, and in my opinion a suitable solution of this difficulty would be the combination of several such towns to secure the services of an engineer to direct and manage their undertakings, each authority having in addition a resident assistant engineer. Such a course would be far preferable to that now obtaining in some towns, where the electrical engineer is placed under the control of the manager of some other department of the Corporation's work; for however excellent such an official may be in his own department of engineering, it cannot be expected that his knowledge of electrical work should be more than superficial, and the effect of the arrangement will almost certainly be to mar the success of the undertaking. Efficient operation must of necessity depend on the electrical engineer, and few men work well or heartily unless they have full confidence in those over them, and are allowed responsibility for their actions, together with the credit or discredit ensuing from them.

I believe that the future of electrical engineering as a profession depends largely upon municipal engineers. Their numbers, and the importance of their undertakings, are increasing daily. In my opinion, the class of consulting engineers will in the future be largely recruited from their ranks, and on the consulting engineer depends, after all, the inception and success or failure of most electrical enterprise. I myself cannot view without the deepest concern and apprehension the present tendency of many electrical engineers. The old traditions handed down by the civil engineers, who have made the reputation of Great Britain as the foremost engineering country in the world, are openly scoffed at, and a large section of men appear to see nothing degrading in canvassing and advertising, and in joining in a competition more worthy of an enterprising cheap-jack than a member of an honourable profession. I have often been told that everyone advertises, and that the only difference is in the form of the advertisement. This I deny. It is true that if good work is done by a man it will be known, but as good wine needs no bush to proclaim its merits, so his work will be known by its results, and it appears to me that few can honestly maintain that this is advertising in the same sense as canvassing and newspaper paragraphs are. It behoves municipal engineers to set a high standard of professional probity, uprightness, and independence—and, if you will, etiquette. If they will only live up to the traditions of the founders of the engineering profession, they can and will save electrical engineering from becoming a mere trade, with the sordid appendages too often connected with commerce.

While speaking of their duties, I would wish to point out a pitfall which awaits engineers no less than ordinary mortals, and that is the danger of being led away by a fashion, a fashion often brought about by what, to use a modern word, is known as "booming." A type of plant, a dielectric, a system of working supposed to be new, is introduced. It operates successfully in one or two cases. Immediately there is a chorus of praise. Every other method and every other type of plant is condemned. The fashion is set, and everyone must rush to make alterations, or he is supposed to be behind the times, without intelligence, and ignorant. On what evidence is the change made? Often on none at all worthy of the name. Let every engineer make his own direct inquiries. Let him try the new thing on a limited scale, and get his own experience of it. Let him use his own reason, and care nothing for what he hears unless it be proved, and then let him weigh well the advantages and disadvantages, and consider whether after all the old methods are not as good as the new, or better, and then let him make up his mind to act quite irrespectively of what other people may think. I venture to prophecy that in the long run he will find that he has done better not only for the undertaking with which he is connected, but for himself and his own reputation, than if he had been in the fashion.

If may not perhaps be amiss if I ventured to give a word of advice to assistant engineers. It would be well if they would bear in mind that all cannot be first, and that in large stations there must of necessity be good secondary berths. In some of the more important towns, the magnitude of the electrical undertaking is at present as nothing compared with what it will almost certainly be in the future, and those who obtain a footing now, and work steadily and contentedly for a few years, will probably find themselves in a far better position at the end of that time than those who, tempted by a small immediate advance of salary, abandon their chance in the large concern, and take a position in a town where the electrical development can never be very great, with the result that they stagnate and become shelved. It is a fatal mistake for a man to be constantly shifting from station to station. A certain amount of variety of experience is, of course, necessary, but it is those who are associated with the development of an undertaking, and who evince an interest in its affairs, and concern for its well being, who will ultimately succeed.

A matter which very closely affects committees, and more especially their chief engineers, is the question of the provision and supply of an adequate and competent staff. At the present time, when so many new stations are springing up, this difficulty is aggravated, for new berths are being created week by week, and a supply of engineers in charge must be had, and is naturally drawn from assistants at stations, even though these assistants may have had no experience whatever of the managerial portion of the work required. And let it be understood it is as important for an engineer in charge to be a good manager as a good engineer; neither one class of knowledge nor the other can be dispensed with; both must be combined in one man if the undertaking is to be a commercial success. No doubt the present state of things is temporary. There must arrive a time before many years are over when practically all towns of any importance will have established their electric supply stations, but meanwhile the problem confronts us, how are we to retain our assistants, and if they secure good positions, as it must surely be the desire of us all that they should, how are we to replace them?

In the first place, the example set with reference to chief engineers should be followed by corporations with respect to their principal assistants. They must be adequately paid, and in the case of large towns they must be paid such salaries as are at least as good as, and preferably above, those paid to the engineers in charge of smaller stations. This is a *sine qua non*, for whether rightly or wrongly a man will naturally always prefer to be chief of his own little station rather than be an assistant at the same salary in a larger station.

Next there is the problem of filling up vacancies occasioned by the removal of assistants. Whatever the system of supply adopted, there is in every station a large amount of detail work peculiar to that station, and no stranger coming in fresh to the work is of the slightest use as an assistant until several months, or at any rate a good many weeks, have elapsed. There should always be a number of understudies in a large works ready to step into the shoes of the man ahead of them at a moment's notice. How are these understudies to be provided? In my opinion there is but one way, and that is by the taking of engineering pupils. There is everything to recommend this practice, and nothing substantial against it. Central station work is a specialised form of engineering. It can only be learned in a central station, and therefore it is as well to recognise at once that the work must be taught. To take another aspect of the question, not only is the teaching of experience valuable to the pupil, but if properly selected the services of the pupil are of value to the Corporation, and they tend to diminish the cost of production, inasmuch as they are rendered without payment. Again, the premiums paid by pupils afford a ready means of increasing the salary of the chief engineer without an undue augmentation of the works' costs. As regards the payment of such premiums, there can be no doubt that they should be receivable by the engineer, and not by the Corporation, for he has the trouble and responsibility of imparting knowledge to the pupils, while the Corporation receives the services of the pupils gratis, as compensation for the use of their plant for teaching purposes. In my opinion, a percentage of the premium should be paid to the principal assistant, as undoubtedly a portion of the work falls upon him. What, then, I consider an ideal arrangement of staff is the following:—Each year a certain number of pupils (say three), would be selected carefully by the engineer from men who had just completed their education at a technical college, and who had, if possible, had experience for a year or two in mechanical workshops. Such men would be useful very soon. They would be articled for two years. At the end of that time, if vacancies existed they would become junior assistants, and would be paid a moderate salary. If no vacancies existed, they would readily find employment as assistants in smaller central stations. When they had become assistants, or had left, there would be in the works three pupils each with a year's experience, and three new pupils. Those who were selected to remain as junior assistants would be competent to take charge of a shift, and would remain with small annual increases of salary as assistants until the principal assistant left, or some suitable berth offered in another station. The chief assistant would have under him the junior assistants, and it should be the policy of the Corporation to retain this chief assistant permanently, provided, of course, that he renders loyal and efficient service to the undertaking. They then have an understudy for their chief engineer should he relinquish his post or succumb to the wear and tear of its responsibilities. Briefly, then, the chief engineer and his principal assistant should be encouraged in every way to remain as fixtures, while the fact should be faced that there must of necessity be a constant succession of junior assistants, the supply being kept up by means of pupils trained in the works where they will be required.

Such a course as that above sketched out would not only tend to the convenience and efficient working of municipal concerns, but would inevitably tend to materially raise the status of supply engineers, for instead of their being selected at random and drawn from any class haphazard, they would all have gone through a perfectly definite training, which would be on a par with that required in other branches of civil engineering.

I will conclude by thanking the members of the Council for the energy which they have displayed in conducting the business of the Association during my presidency, and while it would be invidious to make any distinction, I feel that I must bear testimony to the extremely able and energetic manner in which our honorary secretary, Mr. Mountain, has performed the onerous duties which have fallen upon him.

THE MERCHANDISE MARKS ACT SELECT COMMITTEE.

Evidence by Mr. A. Siemens.

At the sitting of the Select Committee of the Merchandise Marks Act presided over by Sir James Ferguson on Monday, evidence was given by Mr. Alexander Siemens who stated that he was a director of Messrs. Siemens Bros. & Co., Limited, of 12, Queen Anne's Gate, Westminster, and was giving evidence on behalf of the Machinery User's Association, and of the London Chamber of Commerce.

By a Member: In your opinion the aim of the Merchandise Marks Act to prevent fraud is one in which every honest trader would concur, and every honest trader would like to see strengthened? Yes! As far

as the prevention of fraud goes, I think the Act cannot be made strong enough, but one of the effects of the Act has been to disclose to customers abroad the fact that a great part of the commerce of Great Britain is carried on by buying and selling goods foreign made. As an illustration I will give you my experience in Brazil. I was up the Amazon River, and in a small creek a trade depôt was established, and I was showed a match-box, and asked what the additional mark was. I explained that it was "Made in Germany" and the man replied "That is very funny, for a German traveller offered me the same boxes but as I always bought from Britain, I did not like to sever the connection, but if they manufacture these goods in Germany I may as well get them from the German traveller." He also said the traveller had got an assortment of things, and he asked the question, "Do the British manufacture anything?" It sounds ridiculous, but so it is. What I want to bring out is that it does not affect particular goods, but travellers of foreign firms are able to extend their dealings to other goods formerly supplied by and still manufactured in England. The best proof of what a powerful aid the working of this Act has been to foreign competitors, is the fact that it is now the custom of German manufacturers to mark all their goods for export "Made in Germany" or even "Warranted made in Germany" in addition to the name of the firm who supplied it. In consequence the administration of the Act has thus damaged the shipping and transit trade without in any way detecting fraud or preventing the introduction of foreign goods with English marks to customer's abroad.

How do you make good that contention that the administration of the Act has in no way detected fraud or prevented the introduction of foreign goods with English marks to customer's abroad?—Anyone wishing to commit that particular fraud has only to load the goods in an English steamer at Hamburg, which finishes its loading in London, and it is transferred without being disturbed.

But as regards goods intended for consumption in this country, it has done something to detect fraud?—I do not know. It depends upon what you call fraud. You can bring in anything provided that it is not marked, and afterwards you can mark it as you like.

If it be falsely marked, it would be a fraud the Act would not detect?—It would not detect it, and it is not a fraud, because it is the regular custom of every retailer to mark the goods with his own name. I am quite sure the public understand such marks as meaning "sold by."

You mark goods coming in without previous marks with your own name, and that you contend only means that it is sold by you?—Yes.

It would be a relief to you if you could put on your goods "Made by Messrs. Siemens Bros.?"—It might be a relief, but I would much prefer having nothing except our own name, and if we manufacture in this country then we could put "manufactured by."

You would have it understood unless you put "manufactured by" it simply meant "sold by." It would be a negative way of doing it instead of a positive?—I contend I am not bound to give a customer any indication as to where I buy my goods. I have examined and tested the goods, and therefore it must be absolutely indifferent to the customer whether I have manufactured them or merely examined them.

This difficulty arises from the interpretation of the Act rather than its provision? Yes, under Section 3 it is the way the trade description is defined, "any statement or description or other indication, either direct or indirect, as to the place or country of origin, &c.," I would suggest that they be struck out and an addition made in the first clause.

If that practice has now been got rid of, would it be necessary to alter the law. We have it from the Customs that these regulations have been withdrawn? But if the present head of the Customs dies and his successor is of another opinion we have the same thing again. The great damage to trade is done by the uncertainty. If that paragraph is transferred to Section 2 in almost the same words you have protection to the British trader, and you have liberty to import goods which you examine. I do not manufacture all the goods bearing my name, but I examine them. Whether they are made in a factory three doors off or in the next county, it does not matter.

Your name is a guarantee of quality and not of origin? Yes, and that is what the customer wants. Where it is made does not concern him.

Mr. MUNDELLA:—I presume you do business all over the world? Yes! that is the reason I am asked to give evidence. We have to supply telegraphic material and other materials all over the world.

And you are obliged to get your articles from all quarters; from Germany, Switzerland and elsewhere? Yes! not always. We manufacture as much as we can, but sometimes we are obliged to get them from foreign countries.

But there are delicate steel instruments used in telegraphy which are made abroad? Partly! we do not care where they come from if they come up to our standard.

And when they come up to your standard you complain that you cannot put your own name on? We do as far as we dare under the Act. We have to mark where they are made, and our customers have gone direct, but I am glad to say that those who supplied them did so without examining them and our customers have come back.

You think in the interests of trade such interference should not take place?—Exactly.

By Mr. C. WILSON: His firm did electrical lighting and all descriptions of electrical work. He mentioned the Brazil illustration to show how far reaching the effect of the Act was. All civilised countries were much nearer than they used to be, for inventions were patented in all countries. As far as they were concerned as British manufacturers, they wanted to encourage home trade, because they wished to be encouraged by other people.

Mr. MURRAY: Would you object to an alteration of the law so that the words "sold by Messrs. Siemens" might be used?—No; I think the less you put on the better.

You admit that fraud did exist before?—I do not think so; the convictions under the Act have been very few.

You will admit that there was some serious foundation for all these Acts?—I am not so sure about that. In its principle I am entirely with the Act.

But you must admit that you cannot enforce a strong Act without in some cases bringing annoyance on individuals? Yes; what I object to is unnecessary annoyance. If you interfere with goods in transit it simply drives the transit trade out of the country, but you do prevent wrongly marked goods being delivered in other countries.

Sir HOWARD VINCENT: Is it not a fact that your establishment in England has made your reputation in the world?—There is the German firm, but we are entirely an English firm, and have nothing to do with the German. Wherever the goods are manufactured we examine them, and if they are up to our standard we put on Siemens products.

Can't you put it on now?—Yes; if we also put on "Made in Germany" or "Made in France" or elsewhere. I want to strike that out.

Why?—When our customers find we buy goods in France they will go there to buy them, and they do not confine their purchases to that article but buy other things.

Mr. MUNDELLA: You supply a complete range of articles for telegraphic or other electrical work?—Yes.

And only one or two are made abroad, and the rest in England?—Yes.

But one article being marked raises a suspicion as to the others?—Yes; we receive orders to put up so many miles of telegraph in a hurry, and we have to buy things where we can get them, but we examine everything, and what has given us our name is that we are careful to supply nothing except the best.

Sir HOWARD VINCENT:—You are an English subject?—Yes.

Mr. MUNDELLA:—And has done a good deal by England too.

CORRESPONDENCE.

"Uninsulated Iron Pipe Wiring."

While fully agreeing with your correspondent that experience alone can settle the vexed question of pipe wiring, whether it is to be insulated or otherwise, and without in the least wishing to become a partisan of either faction, I should like to be allowed to differ from "G." in at least one of his statements. He avers in the last paragraph of his interesting letter that "solid drawn steel pipe is far smoother in the bore than insulated barrel." This is doubtless the case with respect to the majority of insulated pipes now on the market, most of which present anything but a smooth surface to the passage of the wires. Your correspondent, however, has probably not had an opportunity of inspecting one of the latest additions to the insulated conduit systems—one which, from my own experience, possesses a smoother bore even than specially drawn steel pipe. "Armorite"—the insulated pipe to which I refer—is a distinctly new departure, and is formed by inserting a wooden lining into a tough iron barrel.

The wood is shaped in two pieces, semi-cylindrical in section, with the corresponding edges of each rabbited and tongued to fit those of the other section. Before being forced into the pipe, I understand that the wood is creosoted, and the effect of this treatment upon the hard wood already accurately planed is to afford an easier surface for the passage of conductors than is obtainable in the smoothest bored iron or steel pipe ever drawn.

One of the strong arguments of which advocates of bare pipe have hitherto had the monopoly is that in all insulated systems the pipe has to be obtained and fixed in certain given shapes and bends, whereas with plain iron or steel barrel any required shape can be readily obtained by heating, or even by bending cold. Now in using "Armorite" it will be found that *it can be bent cold* on the job to suit any position, and this without in the least affecting the interior insulation. I have proved this by bending a piece of "Armorite" to form a curve having a radius of not more than 6 inches, leaving the straight ends of tube inclined at a right angle. On cutting the pipe through at a point in the curve the wood lining was intact and quite unaffected, while the size of the bore was not appreciably lessened.

I hope I shall be excused if I seem to champion a particular make of article in your hospitable columns, but "Armorite" is a new boy and has few friends yet (in this country, at all events) whereas his competitors all have their protectors to fight their battles for them—and some of them, I must say, proclaim their protégés's merits

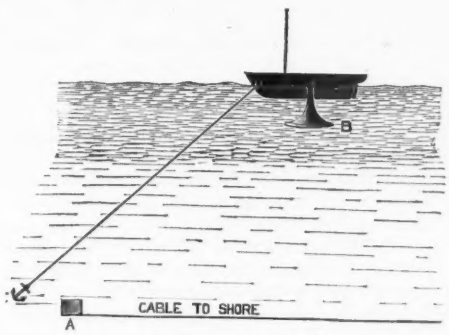
with no uncertain voice. Possibly when "Armorite" has been thus introduced and safely piloted through his first term—no doubt having one or two "dust-ups" with his rivals in the same Class, by the way—he will be able to take his own part pretty effectually.

M. Blencowe Cotterell.

Aston, Warwickshire.

"Induction Through Sea Water."

It would seem much simpler to use sound waves instead of induction as one of the links in the means of communication from the shore to a lightship (and *vice versâ*). The method proposed is indicated in the sketch.



A, an electric bell which can be rung from the shore. It is situated near the end of the mooring chain. B, a funnel, to the end of which is attached an ear piece, which is situated in a small room in the light-ship, and the whole insulated as far as possible from any noises in the ship.

I feel sure that rough weather would not prevent the bell being distinctly heard.

Archibald H. Finlay.

Competition in Electricity Supply.

It has been generally considered that competition in any industry tends to the advantage of the public; but this is not always the case, at least in the supply of electricity, as has lately been demonstrated at Hampstead. In this district there are two stations, one owned by the Vestry, the other by a company, and there is naturally a keen competition between the two to secure new customers.

A flat was recently wired for 20 lights, and an application made to the company to connect the installation to their mains. The company's engineer tested the insulation resistance, and found it under half a megohm, which was, of course, too low to meet their requirements, which are at least 1 megohm. The company refused to connect the installation until the faults were rectified, and naturally expected that the wiring contractor would put the matter right. Instead of this, however, an application was made to the Vestry, who apparently jumped at the idea of securing one of their competitors' customers, and agreed to connect the installation to their mains, although the insulation resistance is less than one-seventh of that required by their rules. The result of this action on the part of the Vestry is to leave customers and station alike at the mercy of the contractor, who can put in the cheapest and worst form of wiring possible, and still have it passed and connected to the mains, while the customer may have an installation which will give endless trouble.

We have generally considered corporations above reproach in all such matters, and the stringent regulations and high moral tone of their rules lead one to expect a standard of electrical purity that outsiders can scarcely hope to attain; but from the above instance it would appear that these excellent regulations are "more honoured in the breach than in the observance."

A. W. Armstrong,
Managing Director, London and Hampstead Battery Company.

RÖNTGEN RAY DIFFUSION PHENOMENA.*

By ELIHU THOMSON.

It is well known that many substances subjected to the radiation from an excited Crookes tube diffuse the Röntgen rays received by them. It is known also that the diffusive effect is produced throughout such substances or media. The condition resembles turbidity or milkiness with ordinary light. It is probably owing to the relative transparency to the rays of such substances as solid paraffin, wood, &c., as compared with dense metals, that the former possess the greater diffusive power. With the dense metals, when the surface receiving the rays is smooth and flat, a portion of the rays undergo regular reflection as demonstrated by Prof. Rood, of Columbia College, New York, and the diffusive action is less marked. A heap of calcium tungstate crystals appears to be entirely devoid of diffusive action on the rays. This may be owing to the conversion of the energy of the rays into ordinary light without residuum. What diffusion there is takes the form of light of fluorescence.

Barium platino-cyanide is, however, feebly diffusive. By the use of a form of Crookes tube of the single focus type designed by the writer for obtaining strong radiation, tests of diffusive action are rendered comparatively easy and simple. The tube referred to is one in which the glass wall closely surrounds the platinum target, so that one may work very close to the bombarded spot, especially if a magnet be used to deflect the spot towards the edge of the platinum and near to the glass wall.

With such a tube placed horizontally, the rays emitted may pass immediately to the object or substance to be tested. This may rest upon a piece of heavy sheet lead, as this metal has itself but a very slight diffusive action. The substance is placed for testing upon the plate in the most favourable relation to the Crookes tube, and may be in the form of a lump, slab, or a mass of crystals or granules. A convenient receptacle for liquids is a rather deep leaden cup. For observing the diffused rays a fluorescent screen may be used, but must be thoroughly protected from the direct rays of the tube. For a suitable screen tube the writer has used a piece of heavy brass seamless tubing about 8 inches long. Upon one end of this is fitted a wooden eye cap, shaped to exclude side light when placed around the eye, and its interior is blackened. At the other end and within the tube is a cork fitted thereto carrying upon its face opposite the eye a fluorescent substance or small screen of barium platinocyanide, calcium tungstate being more phosphorescent than the platinocyanide is less suitable.

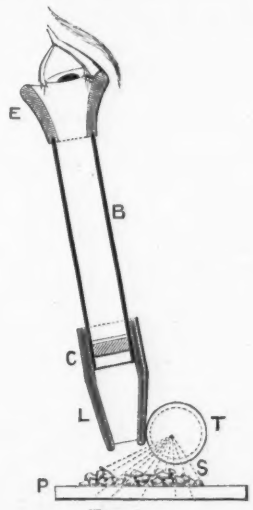


Fig. 1.

The end of the brass tube containing the screen is enclosed by a heavy lead tube or extension covering about an inch or two of the brass tube and surrounding therefore the screen within it, but extending beyond the end of the brass tube 2 or 3 inches. The open end of the lead extension may be somewhat narrowed with advantage.

* We are indebted for an advance proof of this article to the courtesy of Prof. Thomson.

The whole arrangement described is shown in fig. 1, where T is the narrow part of the Crookes tube, S the substance to be tested resting upon a lead plate, P. B is the brass tube with its expanded eye end, C is the screen, L the lead shield preventing direct rays reaching the screen.

These parts may be clamped in relative positions with the lead plate made removable for substitution of the various test substances one for the other.

Some time ago it occurred to the writer to discover if possible whether the diffused rays from any substance had the power of again undergoing like diffusion, which may be called secondary diffusion to distinguish it from the primary diffusion mentioned above.

Some trials made many months' since showed the futility of attempting to get any results of secondary diffusion unless arrangements were made to work at short range with the most intense source and effective shielding of direct and primary diffused rays.

When it is remembered that at the best only a very small per centage of original rays will be sent out as primary diffusion in a particular direction, and that the secondary diffusion will be only a similar small per centage of the first or primary effect, the great delicacy of such a test can be easily understood. In spite of this, however, the writer was able to fully satisfy himself that *secondary diffusion does actually take place.*

By strongly irradiating a small block of paraffin and receiving the rays diffused therefrom upon a second block, he was able to note a feeble illumination of the screen in the screen tube caused by the secondary diffusion from the second block of paraffin. The removal of the second block, or the first block, or of both, left the screen entirely dark.

The apparatus is a modification of that shown in fig. 1, and is shown in fig. 2. Here S^1 is the first block under the strongest rays from tube T. Diffusion takes place upward

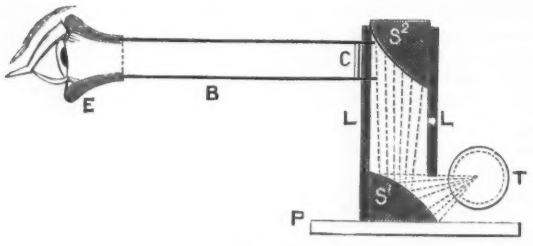


Fig. 2.

from S^1 within the heavy lead tube or shield, L, into the upper end of which is inserted the second block, S^2. Both pieces, S^1 and S^2, are cut on a slant or made wedge-shaped to favour the action. The brass screen tube, B, is inserted into an opening in L L, opposite the second block, S^2. The screen, C, is put as near to the block, S^2, as possible, but not so near as to allow any of the first diffused rays or primary diffusion to reach it. The observer's eyes must be kept in the dark for some time prior to work of the kind, and even the light of the Crookes tube itself should be carefully shaded off. It was only after taking these precautions that the present writer was able to obtain any decided effect, but with them the effect was unmistakable. Other substances not so diffusive for the rays as paraffin is, gave no defined result, though it is thought that with further experience they will be found to act like paraffin, but more feebly. The effect can doubtless be increased by modifications in the arrangement used, and the writer has devised a way which it is thought may multiply the effect several times.

It may be mentioned here that the question of the different wave lengths of Röntgen rays would be elucidated, should it be found that selective absorption or diffusion took place according to the substance used. By changing the substance at S^1, fig. 2, in relation to the other, S^2, or the reverse, interesting relations might be discovered. Again, since paraffin and many other substances diffuse Röntgen rays, while calcium tungstate does not, but instead thereof gives out light, may it not be possible that there exist substances which absorb Röntgen rays and give out wave lengths above visible light in pitch, *i.e.*, ultra-violet rays; and may not the choice of the substance determine where in the range of wave lengths between the luminous and Röntgen orders the diffused rays may be found. It is conceivable, but not probable, that substances exist which, when subjected to Röntgen radiation, may emit rays below the red.

THIRD RAIL v. TROLLEY.

Considering the subject offhand, it is somewhat incomprehensible to any English engineer that his American *confrères* should hesitate seriously for a long time, and argue at great length, over the question of trolley wire or third rail construction for the heavy work of electric railroading, not for *street railways* (or tramways as we call them here); there is no room for discussion in their case; the trolley wire is best and there's an end of it.

But in equipping branch railroad lines like the Nantasket Beach, or the Hartford-New Britain-Berlin section recently described in our pages, the matter is argued *pro* and *con* at great length. Over here we propound a third rail for such lines with as prompt decision as Americans would for trolley wires on street tramways.

The reason, of course, is obvious. With us railroad lines are carefully fenced in from the general public, and trespassers walk on the track or right of way at their own risk, not only of being run over, but of being fined 40s. and costs for trespassing upon the line, irrespective of any further damages they may be called upon to pay for a possible assault and battery upon the company's servant who may order them off.

The danger of shock to passers by and careless workmen is really the sole matter that needs consideration with a third rail conductor system; the excellence of insulation that may be obtained under ordinary working conditions has been well shown on the Liverpool overhead line, and engineers need not be in the least afraid of excessive losses in this direction, provided reasonable care is used in construction.

In many cases, moreover, the cost of a third rail for heavy work is less than half that involved by corresponding trolley wire equipment.

In the New York *Electrical Engineer*, Mr. H. K. Landis describes the method of insulating and bonding the third rail conductor on the Hartford-Berlin line already alluded to. The system adopted is not unlike that which has been so successful at Liverpool. The conductor rail is sloped like an inverted V; and is mounted on pine blocks, creosoted and boiled in tar. These blocks rest direct upon the sleepers or ties.

At joints in the third rail, plain copper plates are used—$3\frac{3}{4}''$ by $12''$ by $\frac{1}{16}''$, with holes punched oval for the bolts; one is placed between a fish plate of the same size and the underside of rail, then bolted up. At crossings, for the copper plate is substituted a brass socket plate with contact surface of 22 square inches. One end of the connecting cable is soldered to the socket; similar arrangements being made at the other end of the crossing. The cable passes underneath the crossing in an insulated wooden trench. Of course the third rail is interrupted at these points.

The line rail copper bonds for return circuit each consist of 21 strips of copper, $\frac{1}{2}$-inch wide and $\frac{1}{8}$ths inch thick, with brass socket heads cast on the grouped together ends. Each head is passed through a hole drilled in the rail base near the end, and is spread out by means of a white metal wedge so as to fill the hole. The rail holes are quite close together, so that the bond is very short, but its construction renders it sufficiently flexible for all practical purposes.

With two of these to each rail joint, the total area of bond for return circuit is about $1\frac{3}{4}$ square inches of copper.

Discovery of Native Aluminium!—Provincial newspapers sometimes contain remarkable pieces of scientific and industrial news. The following announcement, which is to be found in the *Folkestone Herald* for June 26th, is about as marvellous in its way as anything we have seen:—"We understand that, in sinking a well at West Brabourne recently, a thick vein of metal was struck, which has been declared by London experts to be aluminium. If this should turn out to be correct, the consequences of this discovery must be great indeed."

THE MAKING OF METERS.

Unlike gas meters, electricity meters have never been permitted that freedom which, though conducive to ease in manufacture, is destructive of reputation for truthfulness. This may be in a measure due to the exactness with which electrical measurements have been carried out from almost the early beginnings of electrical practice. In spite of the excellence, however, which characterises many of the meters on the market at the present moment, we do not think that makers will find fault with us for saying that the absolutely perfect meter has yet to be evolved. There is no doubt, of course, that in the satisfactory working of electric meters, much depends upon the person who uses them. The manufacturers may send out meters possessing a high degreee of accuracy; but in the hands of an engineer who is unable or unwilling to bestow upon them the attention that is necessary for their well being, they may become hopeless failures when applied to ordinary every day conditions. We could not do better than repeat a remark made in these columns some time ago on the treatment of electricity meters, which was to the effect that "some engineers have been able to get satisfactory results with meters in ordinary central station work, others have not been quite so fortunate; but there is no doubt that the attention and care given to testing and adjustment, to say nothing of erection, have largely influenced these results."

Although one could not very well quarrel with the necessity for great accuracy in supply meters, it must be admitted that the exigencies of manufacture are not too helpful in producing an instrument of extreme precision. For instance, to keep pace with the market, meters must be made rapidly, and moreover, they must be cheap, and the manufacturer who can combine rapidity and cheapness of production with accuracy, obtains undoubted and marked advantages in the competition that prevails throughout the electrical world.

It is not proposed in this article to make a general survey of the art of making meters; one could not well do so without suggesting what would be perhaps be unnecessary and invidious comparisons. The entire object of the writer will be confined to an endeavour to set forth the evolution and the process of manufacturing a special type of meter, and one that is more specifically known as the Hookham. It is hardly necessary to insist on the fact that the electricity meters which have been made for some years by Messrs. Chamberlain & Hookham are among the best known instruments that come within the purview of the central station engineer. It has been a complaint, urged perhaps with more good humour than irritation, that the Hookham meter was being constantly changed in its parts. It is difficult to see how it could have been otherwise; the Hookham meter was first produced at a time when the science of generation and distribution of electricity was imperfectly understood. When alterations mean improvements, they deserve the highest commendation, and in this particular case it can be said that the spirit of change has not affected this type of meter more than the major portion of electrical apparatus. We do not for one moment suppose that the Hookham meter has yet reached finality, and it may be confidently expected that inventive ability

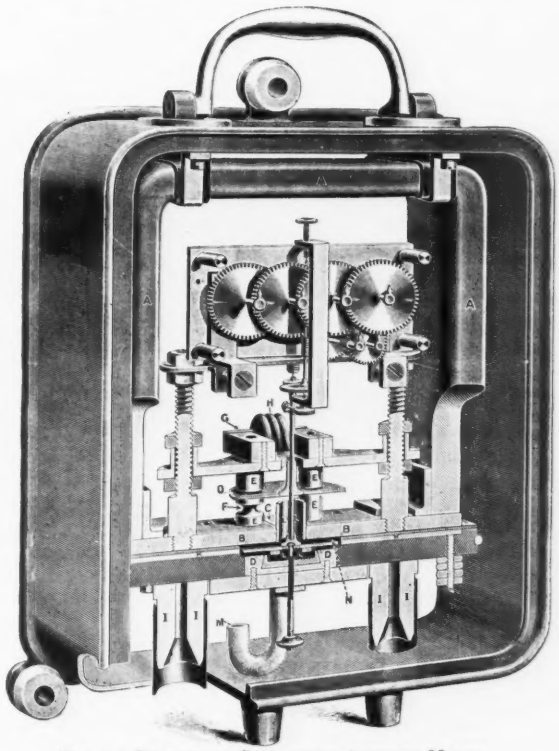


Fig. 5.—Section of Continuous Current Meter.

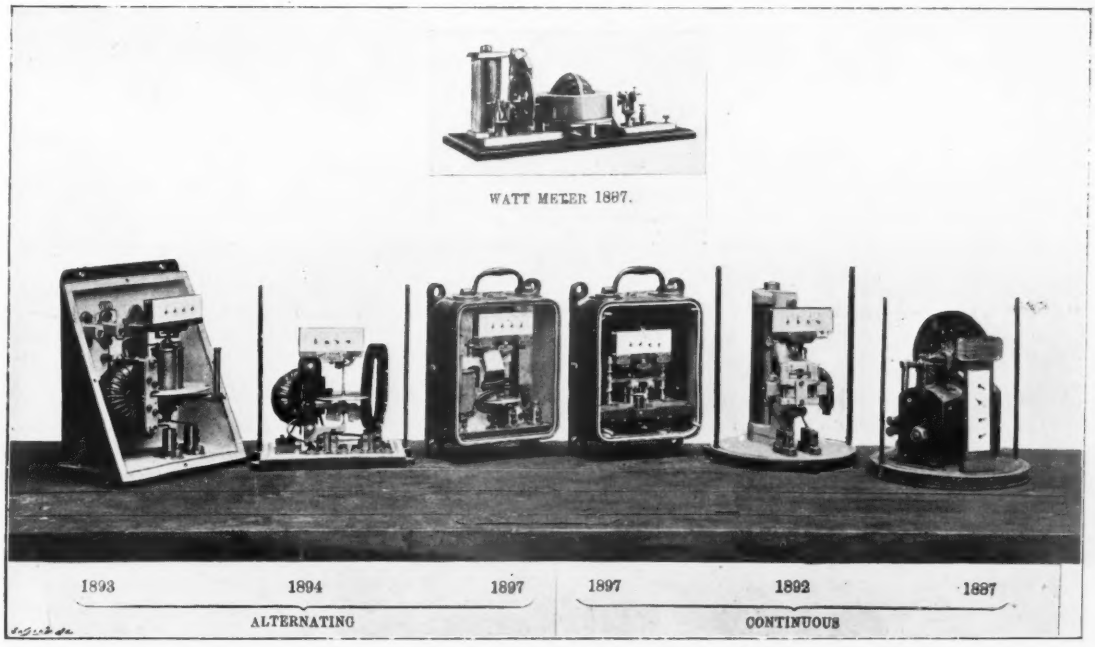


Fig. 1.—A Group Showing some of the Types of Mr. Hookham's Patent Meters.

and the greater experience gained in the process of manufacture will result in still further improvements in this type of instrument.

We have recently had the privilege of visiting the works of Messrs. Chamberlain & Hookham, and have witnessed the process of making meters. It must not be understood that the business of the firm is confined to the manufacture of meters, for a goodly number of dynamos and motors are being regularly turned out. As a matter of fact, this branch of the business was first taken up by Messrs. Chamberlain and Hookham, and they had been engaged on dynamo making for some time before they commenced meter work. Before speaking of the works themselves, it would be perhaps interesting to refer to the two types of instruments most prominently associated with the name of this firm. The latest form of alternating meter we have already described in these columns,* and it is unnecessary to say more about it. The continuous current meter at present made by Messrs. Chamberlain & Hookham is in appearance and construction quite different to the alternating meter.

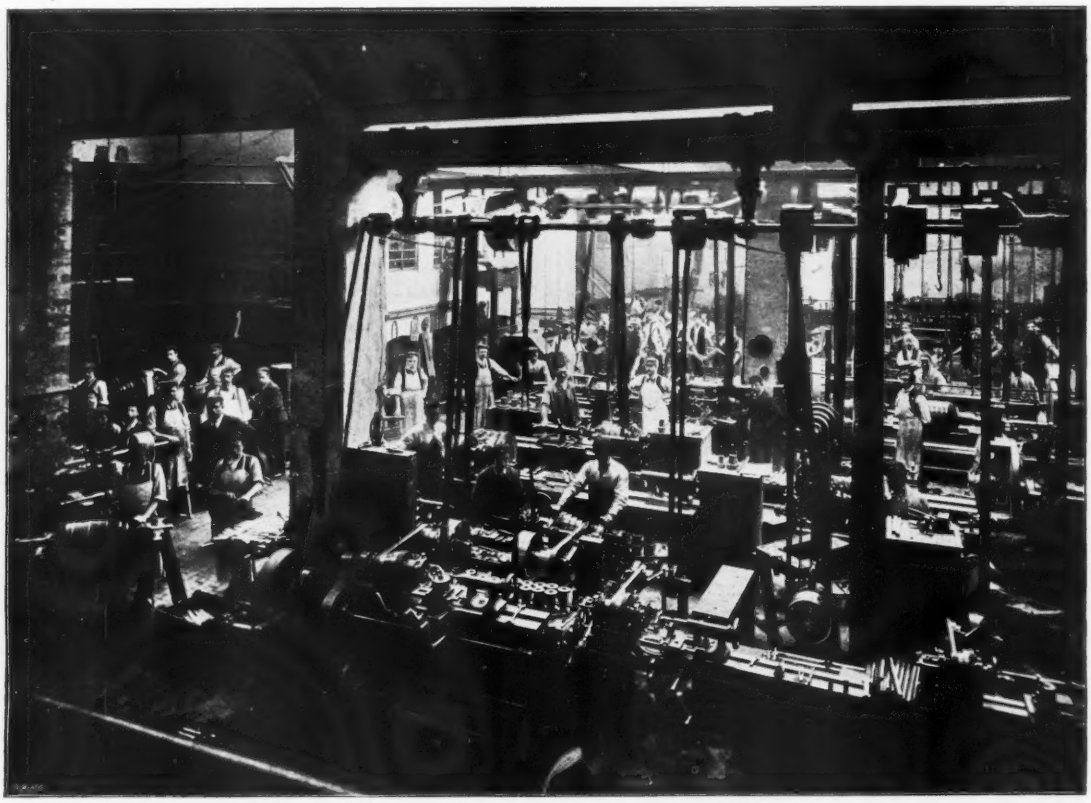


Fig. 2.—One of the Dynamo Shops.

In Mr. Hookham's 1887 patents was first disclosed a self-contained mechanical electricity meter, which consisted of an electromotor, with driving force proportional to the current to be metered, doing work against Foucault currents increasing in proportion to the speed. The original pattern had the drawback that it involved a commutator, and needed a somewhat high starting current. In the 1897 pattern this objection is very much minimised, the starting currents of the various sizes now not exceeding one-fourth of what they were with the type that has been superseded; and this result has been attained, not by increasing the delicacy of the workmanship, and so reducing friction, but by vastly increasing the driving force of the motor, and balancing it by a proportionally increased Foucault brake; the friction being thus relatively, though not positively, diminished.

Another result of employing larger forces is that disturbing causes of all kinds are rendered of less importance, and the curve of the meter from, on the average, one-thirtieth load upwards is, sensibly, a straight line.

While the new pattern retains the essential principles and methods of action, which have stood the test of time, as embodied in its predecessors, a glance at the accompanying drawing will show that the constructive design has undergone considerable improvement, this improvement taking the form of simplification and great reduction in the number of parts. Referring to the section drawing, fig. 5, a single bent bar magnet, A A, of tungsten steel now replaces the dozen or so of straight magnets formerly contained in the brass tube. B B are plates of soft iron continuing the magnetic circuit towards the centre where it is broken by the insertion of a brass piece, C. The lines of force pass downwards through the iron bridge piece, D D, being cut by the armature, N, twice in opposite senses. They also pass upwards through the brake pole-pieces, E E, and the upper iron bridge-piece, G. O is the brake disc; H the correcting coils for fluid friction error; F the reduced saturated neck of one of the brake-pole-pieces; K K insulated strips of copper, conducting the current from the terminals, I I, to the mercury cup, L L, in which the armature is immersed and partially floated. The mercury is carefully insulated from the metal part of the containing vessel except the ends of the copper strips, K K. The armature is slit radially for about one-third of its diameter all round, leaving a continuous area of copper in the centre.

The action of the meter is as follows:—Owing to the great length of the magnet, A A, an intense field is produced at B D, B D. The current flows across the diameter of the disc, being almost entirely confined to the area beneath the pole-pieces (which embrace each about one-third of the periphery of the disc) by the radial slits in the armature. The armature thus cuts the field twice instead of once as in the 1892 pattern. Add to this the much greater intensity of the field, and also that the arrangement allows of the pole-pieces being placed further from the centre, and it will easily be understood that the torque is multiplied from five to seven times.

The power of the brake at E E, E E, is increased in the same proportion, so that the speed of the meter is not increased. The effect of the choking of the brake at F, is in this meter very marked. It will be observed that the armature and brake fields are magnetically in parallel, and con-

* Electrical Review, October 9th, 1896.

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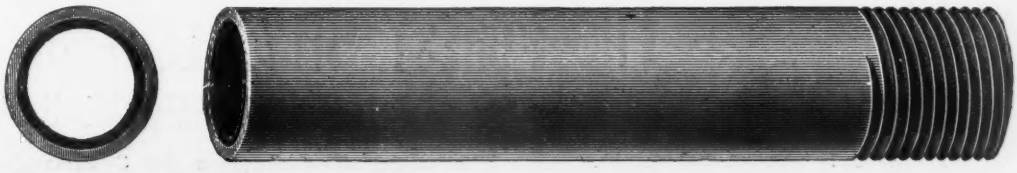

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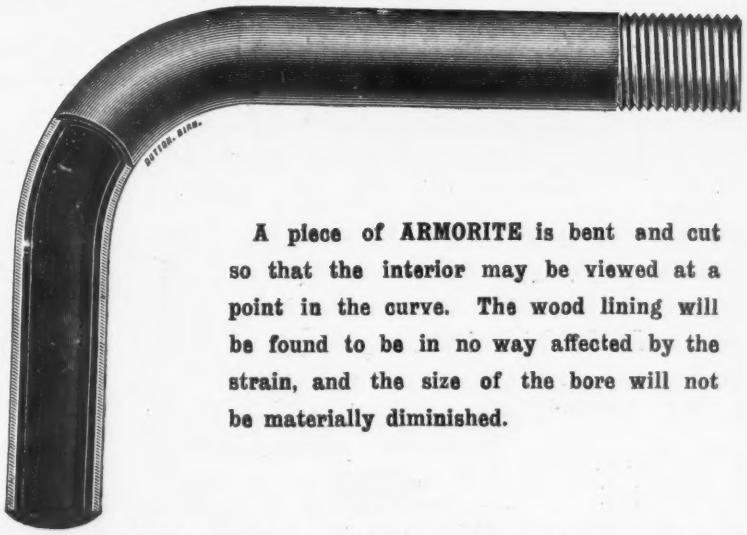

A piece of **ARMORITE** is bent and cut so that the interior may be viewed at a point in the curve. The wood lining will be found to be in no way affected by the strain, and the size of the bore will not be materially diminished.

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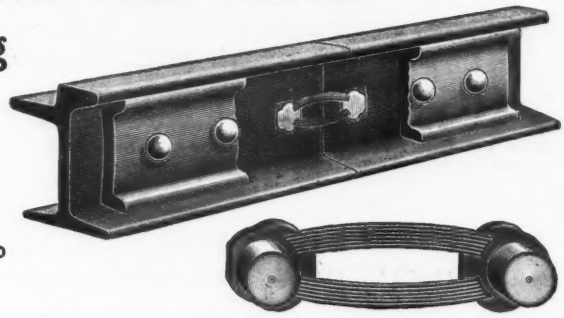

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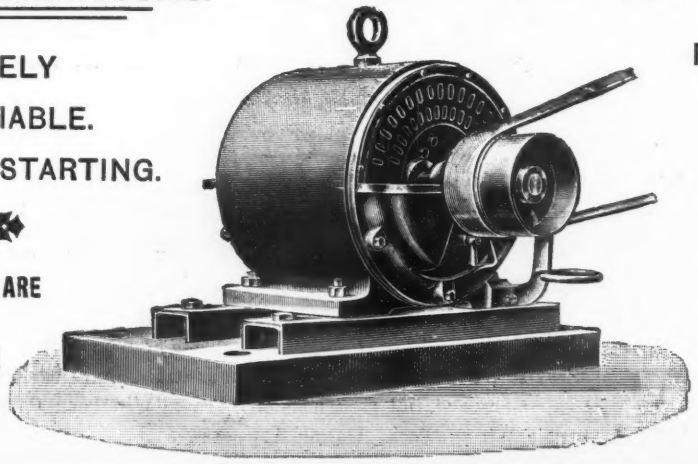

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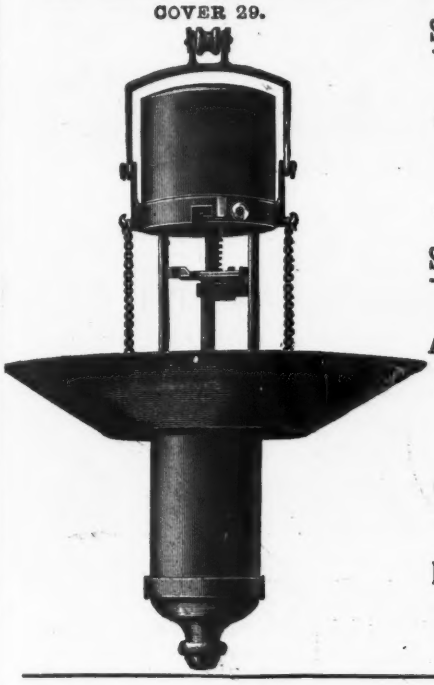

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In the pages of this book are collected the principal tables and formulæ of which the electric street railway engineer makes use in his practical everyday work, arranged in the most convenient manner for practical use.

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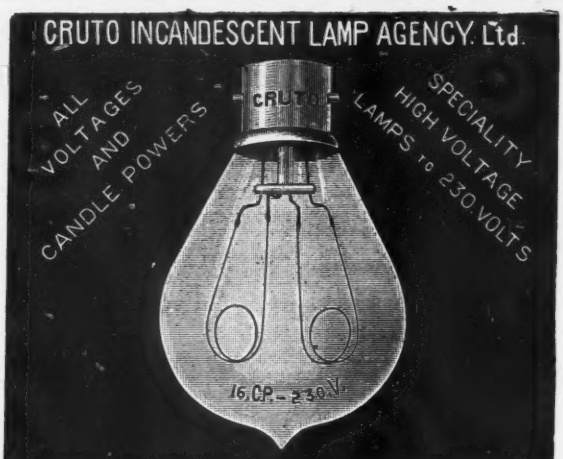

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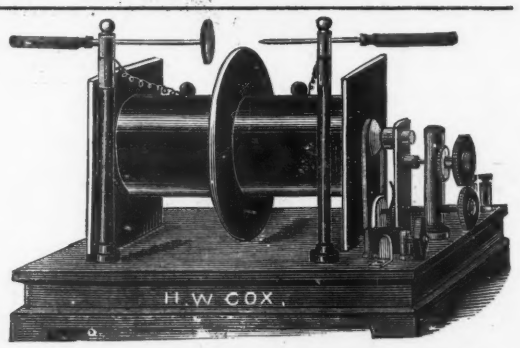

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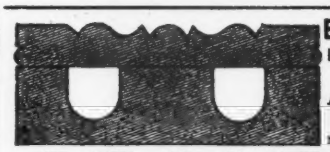

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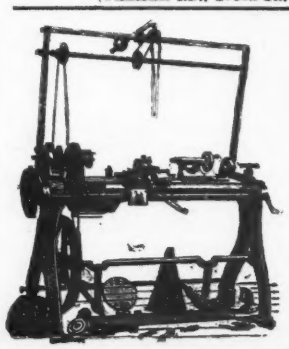

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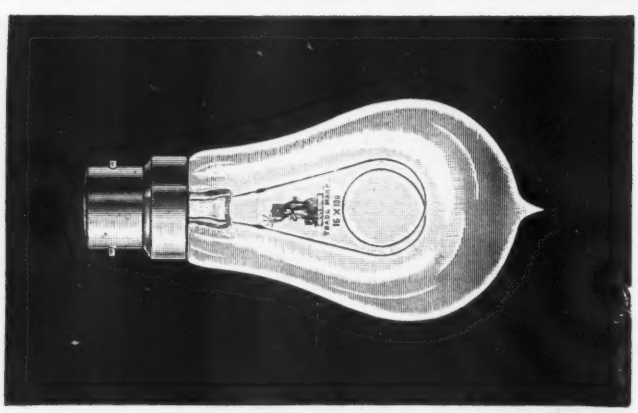

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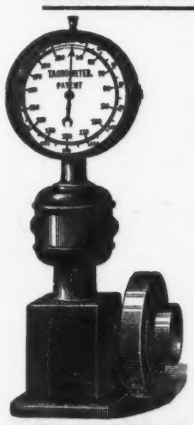

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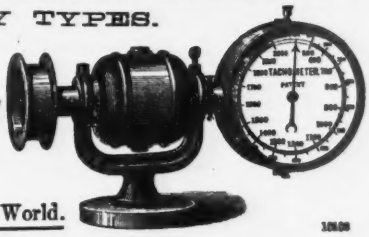

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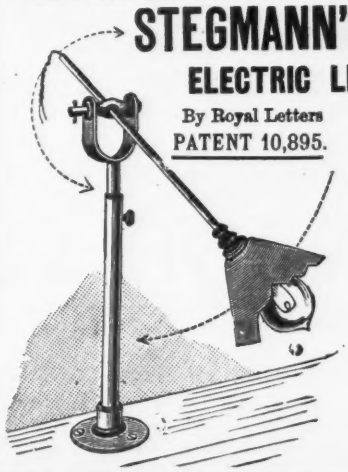

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On and after 1st June, 1897, all lamps issued by this Company will bear our Trade Mark

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Messrs. MELDRUM BROS., MANCHESTER.

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Dear Sirs,

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(Signed) JOHN H. BARKER.

NOTE.—Since the above letter was written we have received the order for the two remaining boilers.

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Several patterns.

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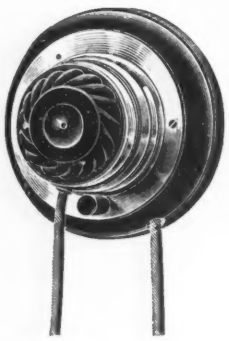

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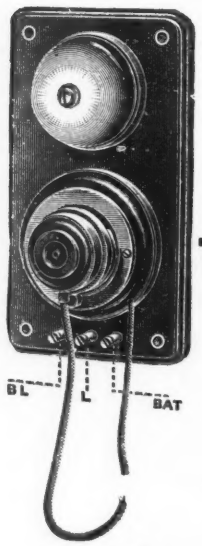

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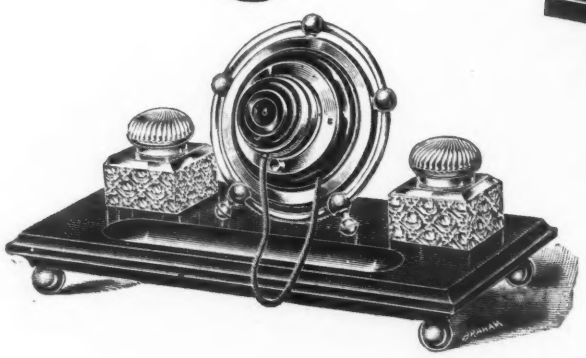

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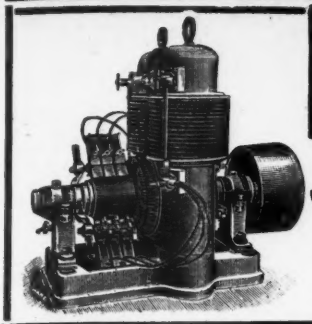

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WANTED.—Clerk in electrical engineer's office, one who has had experience of electrical goods and prime costing preferred, a knowledge of shorthand desirable.—Apply by letter, stating experience and wages required, to "ELEKTRON," 68, Victoria Street, S.W. 1209

WANTED.—An Electrician to look after a small plant, gas engines, dynamos, and accumulators Must be able to wire.—Send lowest terms to "A. B. C.," 180, Broadhurst Gardens, W. Hampstead. 1238

WANTED.—Packer, must have had experience in packing electrical work for export, both glass and brass, as well as the heavier class of goods, such as dynamos. Hours 6 a.m. to 5 p.m.—Apply by letter only, stating age, wages required, and full particulars of previous experience, to "PACKER," J. Stone and Co., Deptford, London. 1221

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London Warehouse: F. WINTER, 138, London Wall, Wood St., E.C.

EBONITE.

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YOUTH Wanted for Electrical Testing in Electro-chemical Laboratory.—Particulars to 1,237, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1237

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ASSISTANT Electrician wants situation, four years' experience; own tools.—1,058, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1058

ENGINEER (26) requires situation, charge of private plant preferred. Good experience with leading firms, mechanical and electrical, good draughtsman and mechanic.—Address 1,067, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1067

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ELECTRICAL ENGINEER (24) desires re-engagement as Assistant in central station (low tension) or as Assistant Electrician. Highest testimonials.—1,226, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1226

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[*Continued on next page.*]

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COMPOUND Dynamo, 60 amperes × 110 volts, also compound dynamo, 24 amperes × 50 volts, sell cheap.—BROOK, Electric Light Station, Brighouse. 1060

DESIGNS by an R.A. exhibitor for electric fittings, wrought-iron gates, drawings for catalogues, &c.—CRICHTON HANNAH, 18, Cecil Court, Charing Cross Road. W.C. 1210

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STEAM ENGINE and Dynamo or Alternator wanted, about 200 kilowatts, immediate delivery. — All particulars and prices to 1,063, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1063

TO ELECTRICAL ENGINEERS.—Through pressure of other work. A Gentleman wishes to dispose of his Electrical Business which he established seven years' ago. This is an exceptionally good opportunity to acquire a high-class connection. Would suit an energetic young gentleman, as advertiser would be willing to help during first year; will bear every investigation, and highest references given. Principals only.—"E. E.," 984, care of Deacon's Advertising Offices, 154, Leadenhall Street, E.C. 1232

WANTED.—A Few Second-hand Electricity Aron Meters, or any other make. Constant current, 100 volts, must be in good order.—State lowest prices to "A. B. C.," 180, Broadhurst Gardens, W. Hampstead. 1234

WANTED (secondhand), 30 to 35 H.P. semi-portable under-type engine and boiler, state full particulars, maker's name, overall space required, and price, to W. H. BECK, M.I.M.E, 115, Cannon Street, London, E C. 1220

WANTED.—Old scrap cable, wire, &c.; any quantity bought. —EDEY & Co, 29, Ludgate Hill. 1082

WANTED, Electric Lamp Tops and Scrap Platinum.—EDEY AND Co., 256, Ferndale Road, Brixton. a1008

L. GARDNER & SONS, DYNAMOS, MOTORS
MANCHESTER. GAS ENGINES.
See Page Advertisement Third Friday of each mon h.

ELECTRIC BELLS, TELEPHONES AND ACCESSORIES,
BATTERIES, PUSHES, &c.

SMALL MODEL DYNAMOS,
10 volts, 6 amperes, 3,000 revolutions per minute, adjustable brush rocker, splendid finish, **Price, 30s. each.**

For Prices of all kinds of Electrical Accessories,
APPLY TO
S. HARRISON, Manufacturing Electrician,
Office—697, ORMSKIRK ROAD, PEMBERTON, WIGAN.
Works—ELLESMERE MILL, NEWTOWN, WIGAN.
Registered Telegraphic Address:—"HARRISON, PEMBERTON." 1107

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FOR AMATEURS,
With Working Drawings, by C. D. PARKHURST, Lieut. 4th Artillery, U.S.A., Assoc.Mem.Am.Inst.E.E.

Chapter I.—A Sma Electric Motor for Amateurs. Chapter II.—A "Home-Made" Electric Motor. Chapter III.—A Sewing-Machine Motor for Amateurs. Chapter IV.—Armature Windings, Connections and Currents. Chapter V.—A Fifty-Light Incandescent Dynamo. Appendix.

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Cloth, Post Free, 2s. Illustrated with Working Drawings.
HOW TO BUILD A FIFTY-LIGHT DYNAMO
OR FOUR HORSE-POWER MOTOR.
By A. E. WATSON.

TO BE OBTAINED FROM
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HOW TO MAKE AN ELECTRIC MOTOR.
By EDWARD TREVERT.
ILLUSTRATED WITH FULL WORKING DRAWINGS.
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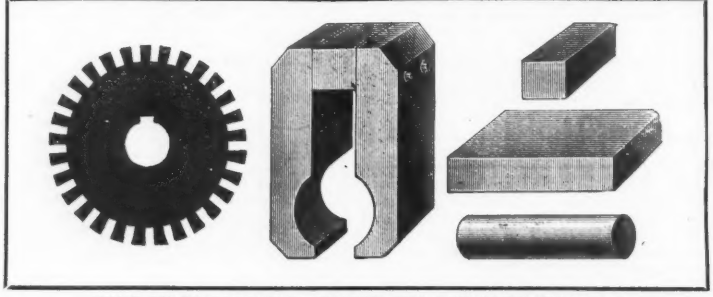
TO MANUFACTURERS OF DYNAMOS, MOTORS, TRANSFORMERS, &c.

STAMPINGS OF ALL DESCRIPTIONS,
DISCS up to 60 inches diam.
SLOTTED WORK a specialty.
Accuracy of Stamping and Highest Electrical Results Guaranteed.



MAGNETS—Forged, Rolled, Cast or Stamped, Finished, or in the Rough.
SLABS & BARS in Suitable Sections for Magnets, Cold Sawn to lengths.

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Telegraphic Address:—"Permeable, London."

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Manufacturing Electrical Engineers,

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Works—BIRMINGHAM.

LARGE FITTINGS

SHOWROOMS

Now open for inspection.

PLEASE WRITE FOR 1897 CATALOGUE. FREE TO THE TRADE AND SHIPPERS.

Official Notices.

LEYTON URBAN DISTRICT COUNCIL.

ELECTRICITY DEPARTMENT.

THE COUNCIL are prepared to receive applications for the post of Engineer-in-charge, who will have to take entire control of an eight-hour shift each day and fulfil any other duties the Electrical Engineer may require.

Applicants must have had recent central station experience. Salary, £1 15s. per week.

Applications, endorsed "Engineer," with copies of not more than three recent testimonials, to be forwarded to me by Thursday Morning, July 8th, 1897.

R. VINCENT,
Clerk to the Council.

Town Hall, Leyton,
June 30th, 1897. 1230

COUNTY BOROUGH OF BIRKENHEAD.

ELECTRIC LIGHTING OF WOODSIDE FERRY

TO ENGINEERS AND ELECTRICIANS.

THE CORPORATION OF BIRKENHEAD are prepared to receive Tenders for the Wiring and Lighting by Electricity, of the above.

Plans can be seen on and after JULY 5th, 1897, and a copy of the general conditions and specification, with form of tender, can be obtained after the same date on payment of the sum of One Guinea (to be returned on receipt by the Corporation of a *bona fide* tender), at the Town Clerk's Office, Town Hall, Birkenhead, or at the Office of Mr. JAMES N. SHOOLBRED, Mem.Inst.C.E., 47, Victoria Street, London, S.W.

The Corporation do not bind themselves to accept the lowest or any Tender.

Tenders, which must be on the prescribed form, sealed and endorsed "Tender for Electrical Wiring and Lighting of Woodside Ferry," must reach me not later than 12 o'clock noon on TUESDAY, JULY 20th, 1897.

By Order,
ALFRED GILL,
Town Clerk.

Town Hall, Birkenhead,
June 30th, 1897. 1228

Official Notices.

ELECTRIC LIGHTING PLANT.

IN consequence of the Library being now lighted from the City's mains, the whole Electric Plant, consisting of 2 Robey Loco. Boilers, 140 lbs. pressure; 2 Engines, Robey's Compound; 2 Thomson-Houston Arc Dynamos; and 2 do., Incandescent, is offered for sale.

Also Screw Cutting Lathe by Matheson.

To be seen here any day, and offers to be lodged with me not later than Thursday, July 8th.

HEW MORRISON,
Clerk to Committee.

Edinburgh Public Library,
June 29th, 1897. 1213

THE CITY OF LONDON ELECTRIC LIGHTING CO., LTD.

40,000 6 Per Cent. Cumulative Preference Shares.

NOTICE IS HEREBY GIVEN that the Transfer Books and Register of Holders of Preference Shares of this Company will be closed from the 5th to the 17th July, 1897, both days inclusive, for the purpose of preparing the warrants for the Interim Dividend payable on the 19th July, 1897.

By order,
J. CECIL BULL,
Manager and Secretary.

1 & 2, Great Winchester St., E.C.,
June 30th, 1897. 1224

THE DUNDEE GAS COMMISSIONERS.

TENDERS FOR COPPER STRIP.

THE DUNDEE GAS COMMISSIONERS are prepared to receive tenders for a supply of Copper Strip.

Specification and form of tender may be had on application to WALTER H. TITTENSOR, City Electrical Engineer, Dundee.

Tenders must be lodged with the undersigned (marked "Tenders for Copper Strip") on or before Tuesday, July 13th, 1897.

THOS. THORNTON,
Clerk of the Commissioners.

City Chambers, Dundee,
June 29th, 1897. 1225

[*Continued on next Page.*]

Official Notices.

VESTRY OF ST. MARY, ISLINGTON.

ELECTRICITY SUPPLY.

WANTED, at once, a First-class Man to fill the temporary position of Canvasser. Only experienced men of good address need apply. Salary, £3 per week and commission.

Written application, with copies of not more than three recent testimonials, to be sent to the ELECTRICAL ENGINEER, 50, Eden Grove, Holloway, N., and to be received by him not later than noon on Tuesday, July 13th, 1897. Personal canvassing will disqualify.

WM. F. DEWEY,
Vestry Clerk.

Vestry Hall,
Upper Street, Islington, N.
June 24th, 1897. 1215

THE URBAN DISTRICT COUNCIL OF MORECAMBE invite applications for the appointment of Resident Electrical Engineer to take charge of and manage the Electricity Works about to be erected.

Applicants must be experienced in the continuous current system, and must be capable of superintending the laying down of the plant, and also of advising and carrying out future extensions.

The salary to be £175 per annum.

The gentleman appointed must devote the whole of his time to the duties of his office.

Particulars of duties, &c., may be obtained from the undersigned, to whom applications, endorsed "Electrical Engineer," must be delivered on or before July 8th next.

JOHN BOND,
Surveyor to the Council.

Council Offices, Morecambe,
June 16th, 1897. 1086

1897, B. 063.

In the High Court of Justice, Chancery Division,
Mr. Justice Stirling.

In the Matter of the Companies Act, 1867,
and
In the Matter of the Companies Act, 1877,
and
In the Matter of the Brush Electrical Engineering Company, Limited and Reduced.

NOTICE IS HEREBY GIVEN that a petition, presented to the High Court of Justice, Chancery Division, on the 13th day of May, 1897, for confirming a special resolution, reducing the capital of the above-mentioned company, from £750,000 to £660,000, is directed to be heard before his Lordship on the 31st day of July, 1897. Any Creditor or Shareholder of the Company desiring to oppose the making of an order for the reduction of the capital of the said Company under the above Acts, should appear at the time of hearing by himself or his counsel for that purpose. And a copy of the petition will be furnished to any Creditor or Shareholder of the Company requiring the same by the undersigned on payment of the regulated charges for the same.

Dated this 1st day of July, 1897,

RENSHAW, KEKEWICH & SMITH,
Solicitors for the Company.

Witness, C. T. PRICE,
Solicitor and Clerk to
Renshaw, Kekewich and Smith,
2, Suffolk Lane, E.C. 1231

Sale by Tender.

COUNTY BOROUGH OF HUDDERSFIELD.

FOR SALE—50-UNIT GENERATING PLANT.

THE ELECTRIC LIGHTING COMMITTEE of the Huddersfield Corporation have for Disposal a 100 H.P. Compound Vertical Brush Engine, and a 50-unit Mordey Alternator (2,000 volts, 25 amperes).

Full particulars may be obtained upon application to Mr. A. B. MOUNTAIN, Borough Electrical Engineer, St. Andrew's Road, Huddersfield.

Sealed tenders, endorsed "Tender for Purchase of Plant," must be delivered, free of charge, addressed in the handwriting of the tenderer or his agent, to the Town Clerk, Town Hall, Huddersfield, not later than Wednesday, the 14th July, 1897.

The corporation do not bind themselves to accept the highest or any tender.

By order,

F. C. LLOYD,
Town Clerk.

Town Hall, Huddersfield,
June 23rd, 1897. 1102

Educational Notices.

THE ELECTRICAL & GENERAL ENGINEERING COLLEGE,

PENYWERN HOUSE, EARL'S COURT.

Principal: G. W. de TUNZELMANN, B.Sc. M.I.E.E. | *Senior Instructor* C. CAPITO, M.I.E.E., M.I.M.E.

Extensive Laboratories, Testing Rooms, Dynamo Room, Steam Engine, Workshops.

Recommended by most of the leading engineering firms. a46

ENGINEERING AND CHEMISTRY.

CITY & GUILDS OF LONDON INSTITUTE.

SESSION 1897-98.

THE Courses of Instruction at the Institute's **Central Technical College** (Exhibition Road) are for Students not under 16 years of age; those at the Institute's **Technical College, Finsbury,** are of an Intermediate Grade for Students not under 14 years of age. The entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships, Fees and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE,
EXHIBITION ROAD, S.W.

A College for higher Technical Instruction for Students not under 16, preparing to become Civil, Mechanical or Electrical Engineers, Chemical and other Manufacturers, and Teachers. Fees for a full Diploma Course, £25 per annum. Professors:—*Civil and Mechanical Engineering*, W. C. UNWIN, F.R.S., M.I.C.E.; *Physics and Electrical Engineering*, W. E. AYRTON, F.R.S., Past Pres. Inst.E.E.; *Chemistry*, H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.; *Mechanics and Mathematics*, O. HENRICI, Ph.D., LL.D., F.R.S.

CITY AND GUILDS TECHNICAL COLLEGE, FINSBURY,
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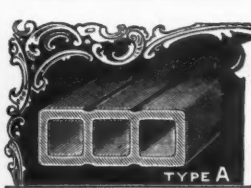
Provides Courses of Intermediate Instruction for Day Students not under 14 years of age, preparing to enter Engineering and Chemical Industries. Fees, £15 per annum. Professors:—*Physics and Electrical Engineering*, S. P. THOMPSON, D.Sc., F.R.S.; *Mechanical Engineering and Mathematics*, W. E. DALBY, M.A., B.Sc., M.I.M.E.; *Chemistry*, R. MELDOLA, F.R.S., F.I.C.

JOHN WATNEY,
Hon. Secretary.

City and Guilds of London Institute,
Gresham College, Basinghall Street, E.C. a1011



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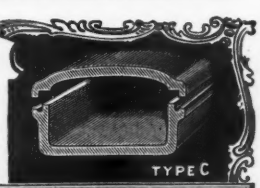
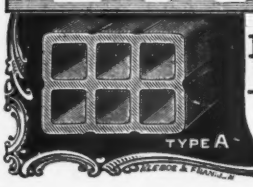


THE PATENT

DOULTON CONDUITS

FOR UNDERGROUND ELECTRIC MAINS



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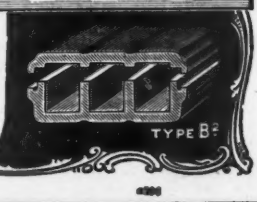

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SUCCESSORS IN THE

AMMETER, VOLTMETER AND SWITCH BUSINESS,

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NALDER BROS. & CO., 16, Red Lion Street, Clerkenwell, E.C.

SOLE MAKERS OF THE

N.C.S.

AMMETERS & VOLTMETERS

For Direct or Alternating Currents.

£1 17 6 UP TO **100** AMPS.

£2 0 0 ,, **160** VOLTS.

HIGH INSULATION,
6-INCH
METAL DIAL,
BRASS COVER,
BRASS BASE,
TERMINALS
AT BACK.

JEWELLED
BEARINGS,
ACCURATE,
RELIABLE,
HANDSOME
MADE IN
ENGLAND.

1896 Type, 6-inch Dial.

Each Instrument has its Scale specially prepared; we do not print our Scales.

CATALOGUES FREE ON APPLICATION.

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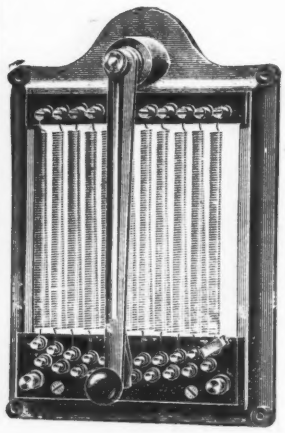
AGENTS:—Messrs. W. McGEOCH & Co., 108, Argyle St., Glasgow; and Mr. S. JEVONS, Electric Stores, Minories, Birmingham. a160

O. BEREND & Co., Ltd., DUNEDIN HOUSE, BASINGHALL AVENUE, LONDON, E.C.

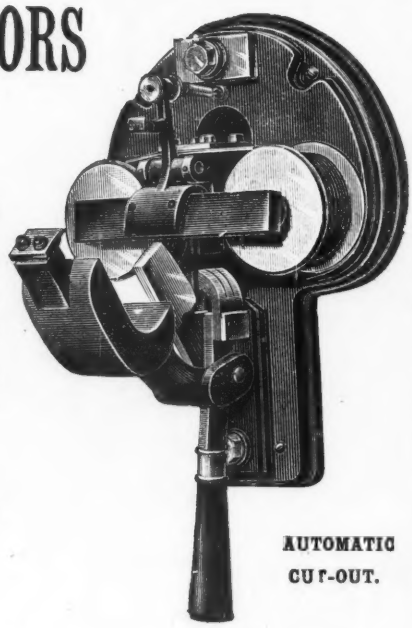
RESISTANCES & REGULATORS

OF EVERY DESCRIPTION.



OUR STANDARD PATTERNS ENABLE US TO PROVIDE FOR ALL ORDINARY DEMANDS, APPLIANCES OF EXCELLENT DESIGN AND WORKMANLIKE CONSTRUCTION AND FINISH.

RESISTANCES & REGULATORS MADE TO SPECIFICATION A SPECIALITY.



AUTOMATIC CUT-OUT.

BEREND'S

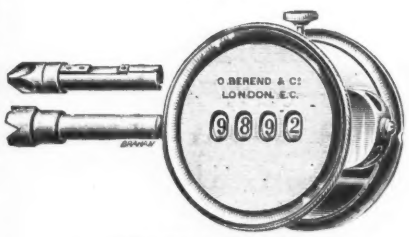
COMBINED SPEED-COUNTER & CHRONOGRAPH,

ANTI-MAGNETIC.

PATENTED.

This Instrument can be used for speeds up to 5,000 or 6,000 Revolutions per minute.

FIG. 1.



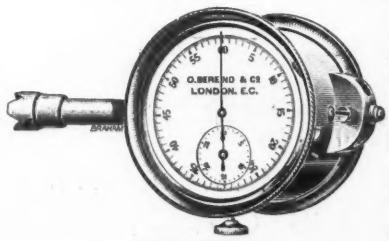
FACE OF COUNTER.

No. 117.

Nickel-plated Case 2" diameter, Enamelled Dial, Anti-Magnetic Chronograph.

With point and hollow bit in elegant case.

FIG. 2.



WATCH DIAL.

Long hand, seconds; small hand, minutes.

A High-Class Instrument, small, elegant and portable, in which both Counter and Chronograph are of the greatest accuracy, well designed and made; the Instrument, therefore, is not liable to get out of order, or require repairs.

☛ REVOLUTIONS & TIME—ABSOLUTELY CORRECT.

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TELEGRAMS: DYNAMO } OLDHAM.
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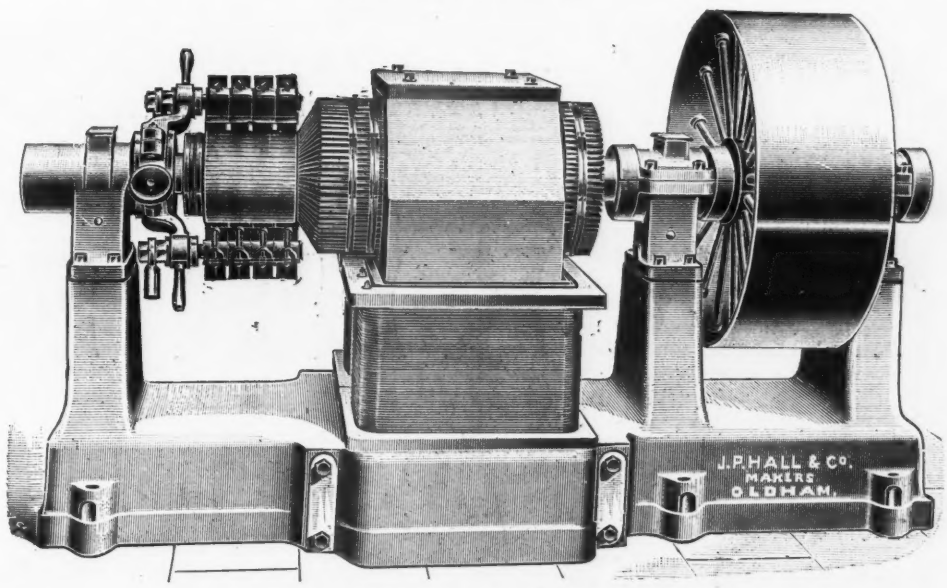

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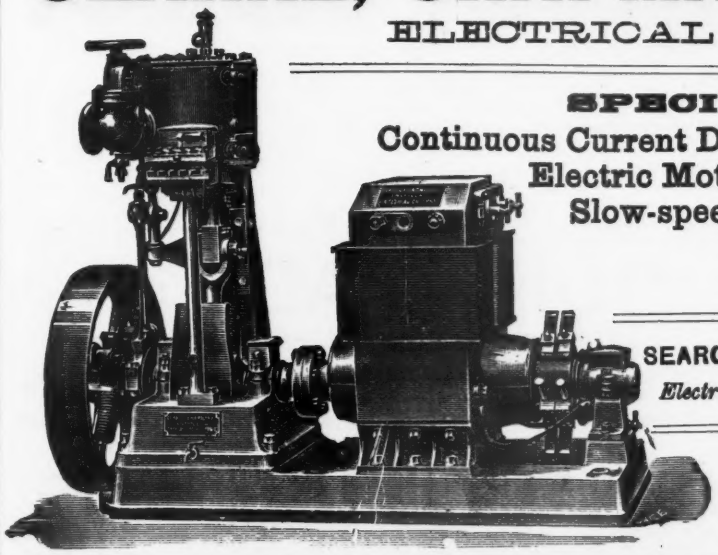

SPECIALITIES.

Continuous Current Dynamos, Alternators, Electric Motors, Slow-speed Direct-coupled Engines and Dynamos For Ship Lighting, &c.

SEARCH LIGHT PROJECTORS, ARC LAMPS

Electric Lighting and Power Transmission.

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GREEN LANE MILLS DERBY.

Manufacturer of Electrical Wires of every description for Electrical Instruments, Dynamo Machines, Telephones, and Electric Bells.

INSULATED LINE WIRES AND CABLES.

London Agents:—JOHN DAVIS & SON, 118, Newgate Street, E.C. a211

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MANUFACTURERS OF

TELEPHONE

and

EXCHANGE APPARATUS.

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CHICAGO, NEW YORK, ANTWERP, PARIS, & BERLIN. 1906

London Office:
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"SWITCHES, BIRMINGHAM."

TUCKER'S

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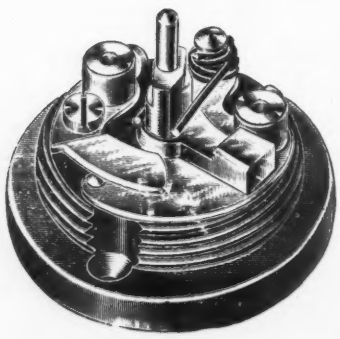

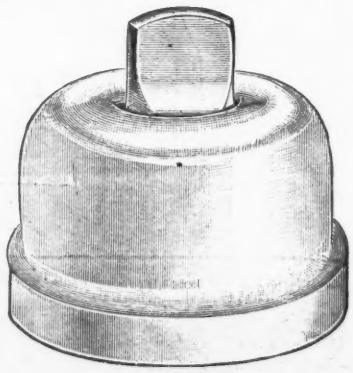

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Good Design. Best Workmanship. Low Price.

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IRON-CLAD RHEOSTATS.

Iron-clad Rheostats take the least room; are perfectly safe; do not burn out radiate heat quickly, and cannot short-circuit. Very low in price.

USED BY MOST OF THE DYNAMO AND MOTOR MANUFACTURERS OF ENGLAND AND AMERICA.

Motor-starting boxes, with and without "Field-Protecting" device; Speed Regulators; Interlocking and other Dimmers; Special Rheostats, reversing, for Electric Cranes, &c., &c.

STEWART ELECTRICAL SYNDICATE, Ltd.,

5, NEW COMPTON STREET, LONDON, W.C. 6884

sequently, the armature field is a by-pass to that of the brake. Now, if there were no choking of the brake, the speed of the meter would increase with any falling off in the induction in the steel magnet. But it is obvious that, with the present arrangement, it would be possible, if the saturation of the necks were carried beyond a certain point, to produce the opposite effect. The brake remaining nearly constant, and the driving force of the motor falling off, the speed would *decrease* with a decrease of field. It is equally obvious that between these extreme effects, an intermediate state is possible in which the speed of the meter is, through a considerable range of intensity, independent of the strength of the field. This point has been ascertained by experiment, and realised in practice, and in the present pattern it is claimed to be possible to apply to the steel bar a demagnetising force of from 200 to 300 ampere turns, without affecting the rate of the meter for practical purposes. One other point remains to be noticed, namely, that whereas, in the former pattern there was an average fluid-friction error of from 20 to 30 per cent. at full load, which was corrected by some 15 series turns, tending to raise the speed as the load increased, in the present pattern, the error is only 5 per cent. and is corrected by about three series turns. The error being so very small, it is possible to apply the correction with great certainty and a straight-line curve is readily obtained: the total result being that the meter is now, both for range and accuracy, exceptionally good. The evolution of the Hookham meter, both of the alternating and continuous type is distinctly interesting, and the various stages through which they have passed are shown in the illustration of the group of meters (fig. 1).

The works themselves are situate in a convenient part of Birmingham, and though they consist for a great part of converted buildings, they are well arranged and eminently suited for electrical manufacture. They are practically divided into two main portions, one of which is given up entirely to dynamo construction and the other devoted to meter making. We need say little about the dynamo construction shop, except that it is provided with a plentiful array of heavy milling and boring tools which, on the occasion of our visit, were mainly employed on the pole-pieces of four-pole dynamos and motors, as well as in the making of Statter machines which are being made by the company under the personal supervision of Mr. Statter. The arrangements of this shop are shown in fig. 2.

Before leaving this shop, however, there is one point we should like to mention and that is the very extensive use that is made of electrical driving. The greater part of the shafting and most of the heavy machines are being driven by electric motors, and this arrangement has permitted not only of the easy extension of premises, but has also kept the main source of power within reasonable and economical compass. Indeed, having regard to the number and size of machine tools employed, the total aggregate horse-power of the main engines is comparatively small. Gas engines are used and are in every case placed in the basement of the buildings. For driving the machine shop a Crossley gas engine of 50 H.P. is connected to a two-pole Hookham dynamo, which supplies electrical energy for the various motors, while in the basement, under the meter department, are two Tangye gas engines, each of 25 H.P. One of these machines drives some portion of the shafting in the meter shop, and the second drives by belting two fairly large alternators of different periodicity, which is necessary in testing the alternating meters. By an arrangement of speed cones the gas engine can drive two smaller alternators at various speeds and periodicity.

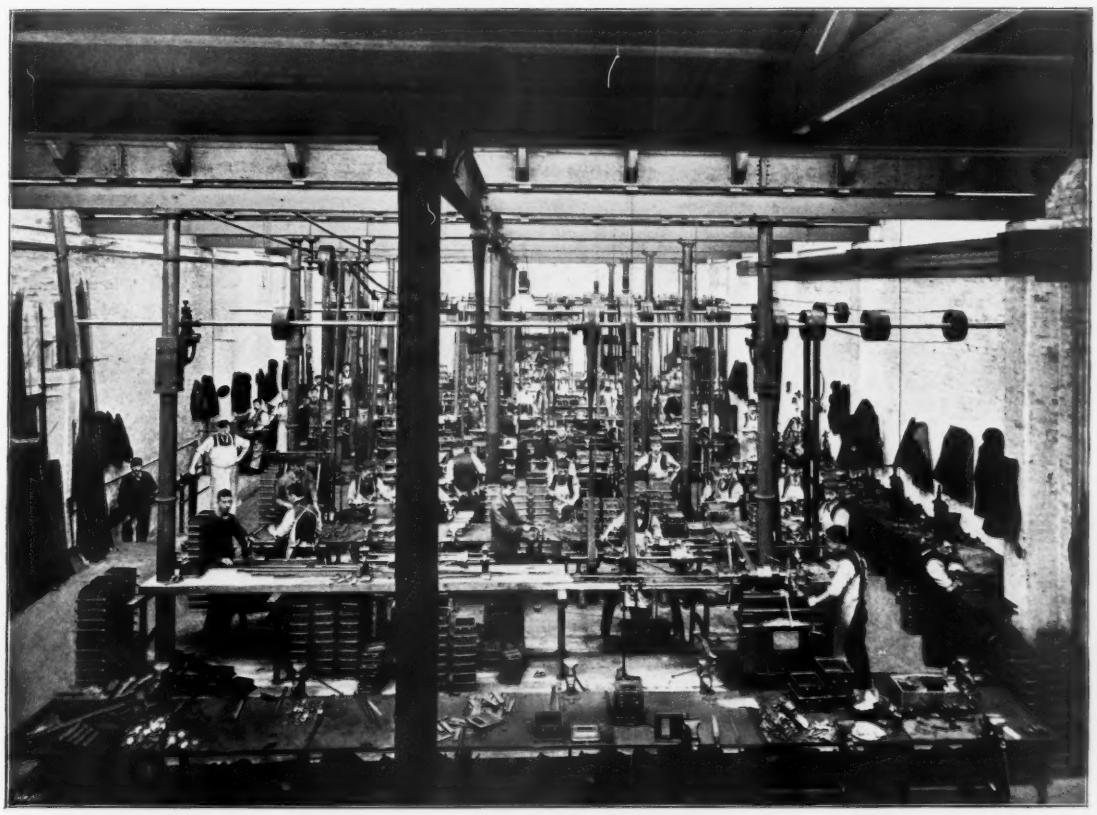


Fig. 3.—One of the Meter Manufacturing Shops.

The shop in which the chief of the meter work is carried on is an admirably arranged building, as will be seen on reference to fig. 3. It is excellently lighted by means of top lights, and is under the easy survey of the foreman at the one end and the electricians at the other. It is in this shop that the majority of the multifarious operations connected with the making of a meter are carried on, and when we say that a Hookham meter of the continuous type consists of 300 parts and the alternating of 250 parts, some idea will be gained of the various processes through which a meter passes before reaching the complete stage.

It is obvious that so many operations necessitate not only the greatest accuracy on the part of the workman, but also unceasing vigilance on the part of the foremen. With

the exception of the meter cases, every component part of the meter is made on the premises. The rough castings for the cases are received here and filed down smooth, and it may be observed that the cases for alternating and continuous meters are exactly alike. With the accuracy that is necessary in building up these instruments, machine tools of great precision are necessary, and many that are employed have been brought over from the States. There are turret lathes turning out screws and nuts with the finest threads, and there are drilling and milling machines doing work of the highest quality.

Although American machine tools are mainly employed, somewhat different methods to those used by Americans are in vogue. It is the practice at Messrs. Chamberlain and Hookham's to reserve each tool for one operation; moreover, each workman, as a rule, confines his attention to one particular branch, and rarely does work outside that branch. While the heavier parts of the meters are made in this particular shop, the making of the lighter parts, and the putting together of the meter, are carried on in other parts of the building. For instance, the armature and armature spindles are made and adjusted in rooms specially devoted to that purpose. Then there is a room specially set apart for the construction of the counting mechanism, which, it is interesting to record, is made by English workmen. Adjoining this room are the departments where the various parts are put together, and the stores where the parts are kept. The system used at Messrs. Chamberlain & Hookham's appears to be of keeping the various parts in stock, and when a batch of meters is required the requisite number of parts are given out to the workmen. There are other rooms where lacquering is carried on and the coils wound. In the winding of the coils a counting mechanism is used, which records the number of turns on the spool.

After the meters are put together they are taken to a room where they are subjected to a kind of rough test. After passing this preliminary inspection, they are next drafted to a room where they are carefully tested under the most stringent conditions. They are put on electrical circuits for a certain length of time, and their behaviour carefully noted under various loads. The room which is devoted to testing and calibration purposes is shown in fig. 4.

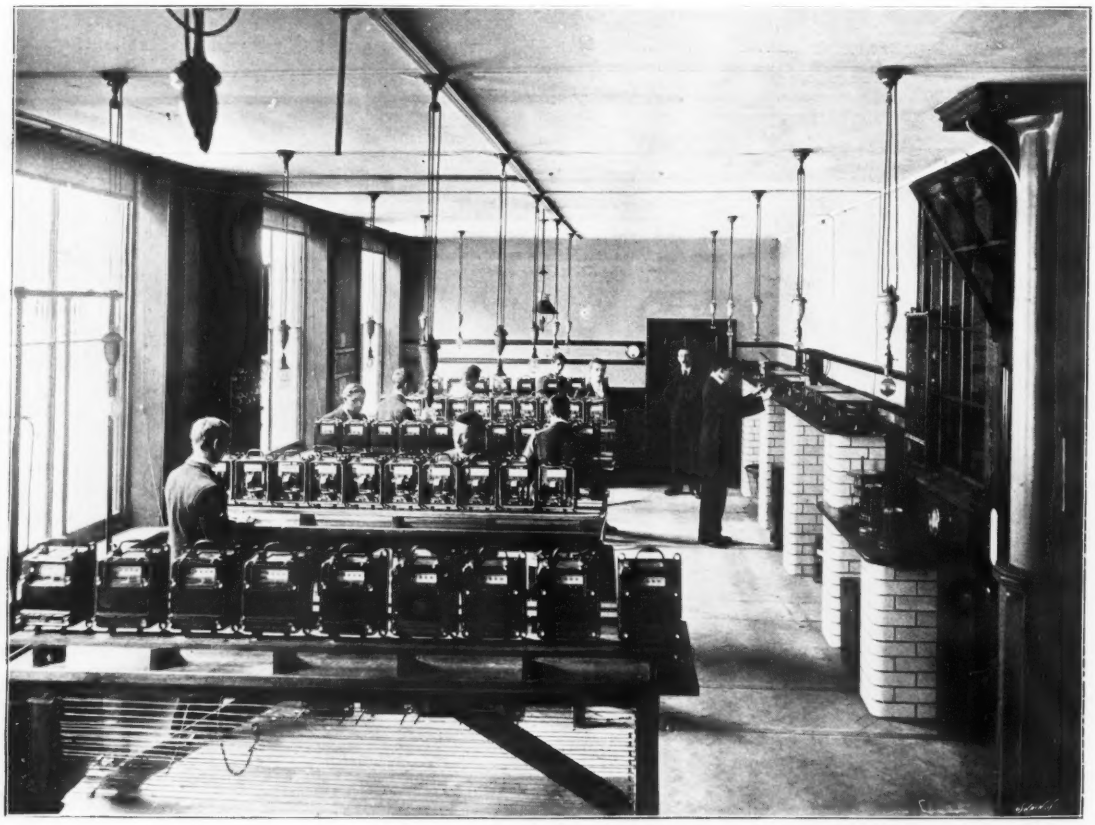


Fig. 4.—A Portion of the Principal Standardising Room.

It may be interesting to refer in detail to the process of testing meters, which is as follows :—

The meters are first of all examined both during construction and after completion by a skilled electrician to see that they are complete and properly put together, and they are then cleaned from dust and fixed in their cast-iron cases.

After this the meters are tested to see that they will run steadily with the minimum current for which they are sold, none being passed into the stock of completed meters until they are satisfactory in this respect.

The next process is calibration; this is performed on batches of 10 to 20 at a time, all of one size (and in the case of alternating meters all must be approximately of the same voltage and periodicity). It consists in passing a current which is carefully measured on Kelvin balances and voltmeters through the meters, and counting the number of seconds occupied by 50 or 100 revolutions of the armature. The position of the regulating devices upon the meter being adjusted until the number of revolutions take place in the correct time, this time has to be known by the tester for each case, and varies of course with the amount of current passing, the E.M.F. at which the meter is required to register units, and the ratio of the wheel train in the counter. The measurements of time are taken with great accuracy down to $\frac{1}{10}$th of a second by means of chronographs specially made for the purpose.

After calibration the meter has to be further tested to see that no possible mistakes have been made in the process, and for this purpose a known current is passed through it for a fixed time, when of course the dials must indicate a corresponding number of Board of Trade units. If quite correct in this respect the meter is tested for insulation, and then after full entries of tests and results have been made it is finally inspected by an electrician who has not conducted the previous tests, and if passed by him handed over to the forwarding department. These processes in their entirety occupy on the average three days to a week, the instruments in use are the best of their

respective kinds, and are checked and compared at frequent intervals. The chronographs are also checked daily.

After an examination of the work carried on at Messrs. Chamberlain & Hookham's, the fact impresses itself upon one that the utmost care and the most rigid supervision prevail in all the operations through which the electrical meter passes, and these are features which could not fail to have an important effect on the future of any electrical apparatus.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending June 29th, 1896.	£	s.
Adelaide	27	0
Albany. Teleg. mat. ...	1,347	0
Amsterdam	75	0
Antwerp...	42	0
Baltimore. Teleg. mat.	28	0
Brest. Teleg. mat. ...	2,500	0
Calcutta	25	0
Cape Town	18	0
Colombo	76	0
Delagoa Bay	175	0
Durban	1,175	0
Flushing	198	0
Gothenburg	83	0
Lisbon	15	0
Melbourne	388	0
Mozambique. Teleg. mat.	17	0
Ostend	372	0
Port Darwin. Teleg. mat.	150	0
Port Elizabeth	1,564	0
Port Said	66	0
St. Helena	8	0
St. Petersburg	55	0
Singapore	16	0
Stockholm	35	0
" Teleg. mat.	175	0
Sydney	499	0
Valparaiso	100	0
Wellington	44	0
Total	£9,273	0

Week Ending June 29th, 1897.	£	s.
Adelaide	658	0
Alexandria	19	0
" Telephones	72	0
Amsterdam	144	0
Bombay	10	0
Brussels	20	0
Buenos Ayres	65	0
Calcutta	406	0
Cape Town	183	0
Cologne	455	0
Colombo	50	0
Copenhagen	85	0
Durban	339	0
East London	85	0
Fremantle	390	0
Gibraltar	10	0
Hong Kong	945	0
Launceston	142	0
Madras	300	0
Malaga	25	0
Melbourne	195	0
Mombassa	14	0
Passages	1,565	0
Penang. Teleg. mat. ...	119	0
Perth	40	0
Port Elizabeth	969	0
Rotterdam	30	0
St. Petersburg	1,089	0
Shanghai	300	0
Singapore	5	0
Sydney	673	0
Vigo. Teleg. cable	36,000	0
Wellington	175	0
Yokohama	58	0
" Teleg. wire ...	163	0
Zanzibar. Teleg. mat.	20	0
Total	£45,387	0

Foreign Goods Transhipped.

	£	s.
Adelaide	14	0

Agency.—Messrs. J. & A. Hillman, of Castle Leather Works, Dudley, have made arrangements with Messrs. J. C. Mackinlay and Co., 27, Walbrook, E.C., to represent them as sole London agents.

Aluminium Prices.—The British Aluminium Company, Limited, has issued a list of reduced prices for aluminium ingots sheets, rods, wire, &c., taking effect on July 1st. The largest reduction is in aluminium rods, the price of which is reduced from £252 to £224 per ton.

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court, held last Wednesday before Mr. Registrar Giffard, an application was made on behalf of George Longfield Beasley, electrician, 14, Sunderland Terrace, Westbourne Grove, Bayswater, for approval to a composition scheme. The debtor failed in April, 1895, with liabilities £565, and assets valued at £320. The scheme provides for payment of 15s. in the £ on all provable debts. The Official Receiver reported in favour of the arrangement, which was approved by the Court under the usual order.

Benn v. Electric and General Investment Company.—In respect to this action, which was reported in our columns a week or so ago, and in which a special jury had found for the defendants on facts to which no further reference than this was made, Mr. Tindal Atkinson, on behalf of the defendants, on Monday, asked the Master of the Rolls and Lords Justices Smith and Rigby to order security for costs as a condition of the plaintiff prosecuting an appeal against the judgment. The plaintiff, the learned counsel said, was an American, having no residence or place of business here; the £100 he had been ordered to lodge as security on his procedure in the court below had been more than absorbed by the costs he had to pay, which had been taxed at £187, and an application to his solicitors for the balance had resulted in a letter from them that the plaintiff had gone abroad, and they were without instructions in the matter. Counsel for the plaintiff, resisting this application, said it was made under a misapprehension. Plaintiff was not an American, but an Englishman with a business in America, and having also a place of business in Copthall Court, London, and this application also ought to have been made not to this Court, but to the Master. The Master of the Rolls said if that were so, and he did not admit it, this Court could act in the matter, he thought, independently of the Master. Eventually, the Court ordered that plaintiff should pay or give security for £25 towards the cost of the appeal he had entered. His counsel said that he did not know what would be done, as plaintiff was away; but the Master of the Rolls said he suspected a means would be found of communicating with him.

Dissolution of Partnership.—Messrs. J. C. Wilson and J. Bastick, carrying on business as electrical, mechanical and ventilating engineers at 27 and 29, Milton Street, Manchester, and Queen Street Works, Denton, have dissolved partnership as and from June 15th. Mr. Wilson will attend to debts.

Dudley Motors.—The Old England Watch and Clock Company's machinery at the Victorian Era Exhibition, Earl's Court, is driven by one of Messrs. Webster, Michelson & Co.'s slow-speed Dudley "C" type motors, and we are informed that it is giving the company great satisfaction.

Electric Fans.—At the Royal luncheon, given by the Lord Mayor at the Mansion House last week, the Egyptian Hall was ventilated by electric fans fitted by Messrs. E. L. Berry, Harrison and Co.

Gas.—Several serious gas explosions have occurred during the past week. On Thursday last week an explosion of gas occurred at a private house in Stokenchurch Street, Fulham. There was damage to life and property.

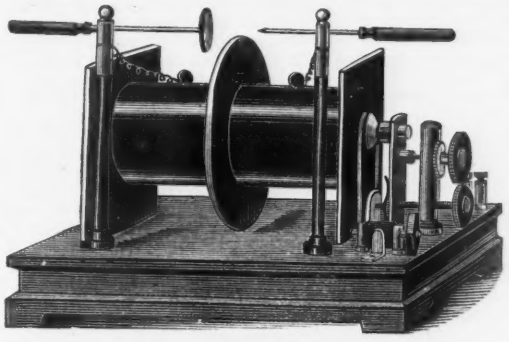
Liquidation Notice.—At meetings of the Gas and Oil Engine and Dynamo Supply Company, held at 100c, Queen Victoria Street on May 25th and June 17th, it was resolved to wind up the company voluntarily, and Mr. E. Lintott, of 1, Queen Street, E.C., was appointed liquidator.

New Offices.—Messrs. Peto & Radford have opened additional offices at 28, Victoria Street, S.W. Communications should be addressed there instead of to 57b, Hatton Garden.

Pressspahn.—The material known as "Pressspahn" is prepared from a specially selected wood fibre, treated with suitable material to enable it to be compressed through rollers into sheets of various thicknesses, ranging from 0·20 mm. to 4·00 mm. It is used for a variety of purposes, such as bookbinding, fancy articles, &c., and also for putting finish on cloth, velvet, or satin; but its chief employment is as an insulating material, capable of withstanding high temperatures, and in this direction it is stated to be invaluable to makers of electrical machinery and apparatus, being largely used in dynamo, alternator and transformer construction, as well as for resistances. It is supplied by the International Trading Company, of 35, Queen Victoria Street, E.C.

Reduction of Capital Petition.—The petition presented by the Brush Electrical Engineering Company for the reduction of the capital from £750,000 to £660,000, is directed to be heard before Mr. Justice Stirling in the Chancery Division on July 31st. See our "Official Notices."

X Ray Apparatus.—Some improvements in the construction of induction coils have been introduced by Mr. H. W. Cox, of Cursitor Street, Chancery Lane, the result of a long practical experience in this class of work. He uses a special insulating composition, has an improved method of securing perfect contact between



coils and end pieces, and constructs the armature so as to secure the maximum of efficiency and durability. There is no trouble with such coils, and apart from gross ill-treatment, a breakdown would seem to be impossible.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The regulations adopted by the Town Council as to the wiring in buildings where electric light is used were the subject of an animated discussion at a meeting held in the Town House on Saturday at the instigation of Councillor Bain. In a case where a firm in the city have introduced the electric light, they have taken the wiring through the centre of the joists beneath the flooring, but Mr. Blackman, the borough electrical engineer, has objected to this, holding that it should be laid in a groove cut in the top of the joisting. Councillor Bain contends that this system would create much risk of fire, because a nail driven into the flooring might penetrate the non-conducting material with which the wires are covered, and if that

were done the woodwork would become ignited when the current was turned on. Councillor Johnston, convener of the Gas and Electric Lighting Committee, strongly defended Mr. Blackman, but Mr. Bain declared that he would appeal to the Board of Trade in regard to the matter. It will be interesting to hear what the Board of Trade says, if that august body takes any notice whatever of the disagreement, which we very much doubt.

Austria.—A battery of 174 Pollak accumulators is being added to the plant at the central station at Zara, in order to meet the extra demand for current.

Bakewell.—The District Council has appointed a committee to consider the advisability of providing electric light for the town as an alternative scheme to the purchase of the gas works.

Battersea.—The Vestry has refused to consider a letter from the South London Electric Supply Corporation, Limited, inquiring whether the Vestry would be disposed to consider the question of the transference of the Battersea electric lighting order to the Corporation.

Bath.—On 24th ult. a Local Government Board inquiry was held as to an application of the Urban Sanitary Authority to borrow the sums of £6,880 and £3,750 for purposes of electric lighting. The sum of £6,880 included extensions of mains, consent to which the board withheld on the occasion of a former inquiry, and £1,000 expenses in opposing the old company's application and costs of the purchase. The £3,750 was for a new roof to the works, extension of the boiler house, &c. Various ratepayers opposed.

Brighton.—On Wednesday, a Local Government Board Inspector held an inquiry at the Town Hall into the application of the Corporation for sanction to borrow £43,300 for purposes of electric lighting.

Chorley.—Messrs. Crompton & Co., Limited, have informed the Council of their intention to apply for powers for an electric lighting supply to the town, and it was resolved to inform the company that if a provisional order was applied for it would be opposed by the Corporation. A committee is to consider whether the Council shall itself apply for an order.

Dundee.—The Corporation last week decided to drop all the clauses of the Corporation Bill, except those referring to the borrowing powers and the extension of the electric lighting area.

Edinburgh.—At the monthly meeting of the directors of the Philosophical Institution, specifications and tenders for the electric lighting and other improvements in the rooms were under consideration, and it was resolved to proceed with the work at once.

Leicester.—At Tuesday's Council meeting Alderman Lennard, the chairman of the Electric Lighting Committee, moved the adoption of the report of that committee recommending an extension of the electric lighting plant and mains, and making application to the Local Government Board for sanction to borrow £33,719. In the course of his remarks, Alderman Lennard said that when three years ago the Council erected their present central electric lighting station, everyone thought it would suffice for the purposes for which it would be required for at least six or seven years. The generating plant which was put down exactly 3½ years ago was capable of producing 675 kilowatts, but the present and probable demand for the light practically exhausted the strength of the plant, and justified the committee in coming before the Council and asking sanction to expend a sum of money which would enable them to double the capabilities of the station. As an illustration of the growth made by the electric light in the borough, he would like to point out that for the half-year ending June, 1896, the output was 96,000 kilowatts. In December, 1896, the figures had risen to 147,500 kilowatts; for the half-year June, 1897, they were 146,000 kilowatts; whilst for the half-year ending December, 1897, it was estimated that the output would have reached 221,000 kilowatts. In order to meet the demand, the committee proposed that four 350-kilowatt inductor alternators should be erected in place of the present three 200-kilowatt and one 75-kilowatt alternators, and the committee recommended a type of dynamo known as the inductor alternator, which was performing some splendid work on the Continent. The present contractors to the Corporation were the owners of the patent for this new machine for this country; but seeing that they had not yet made a machine anything like those which had been seen on the Continent, and that they were not able to make them by a certain date, the committee suggested that although they should purchase the machines through them, they should be made by the most experienced makers on the Continent; as no doubt the machines would be much better than they would be if made in this country. He admitted it was a shame, but contended that the Committee were performing a national duty in doing what they were, for in bringing the machines into this country it could not fail to act as a technical instruction to our own engineers and electricians. The present building and generating plant cost £24,455, or £36 5s. per kilowatt, whilst the new alternators and dynamos would cost £38,240. The report was adopted after slight opposition.

London.—The L.C.C. Highways Committee reported on Tuesday that notices had been received from the City of London Electric Lighting Company of intention to lay mains and to construct two street boxes in Winchester Street, Southwark, and that the conditions attached to the sanction of works were that the company gives two days' notice to the Council's chief engineer before commencing the works, and that adequate means be taken to prevent the accumulation of gas in the conduits and boxes.

Mullingar.—A qualified engineer, "with a knowledge of electric lighting plant," is wanted for the District Asylum at Mullingar. "Salary £70 per annum, all found, including clothing." Applications to be sent to the medical superintendent on or before July 5th.

Paisley.—At a meeting of the Electric Lighting Committee, held on Monday, the tender of Messrs. Fullerton, Hodgart and Barclay, Paisley, amounting to £246 for a 15-ton overhead travelling crane, was accepted. The tenders for boiler feed pumps were considered, but no decision arrived at. The Council have accepted Messrs. Callender's Cable and Construction Company's tender for an extension to the high tension mains outside the compulsory area, through Calside, Castlehead and Castle Street, forming a ring main with the high tension feeder running west. The total length of the extension is 3,177 yards, and the contract price is £1,601. The Council have also sanctioned the extension of the low tension mains through New Smithhills and up the West Brae to Oakshaw. Messrs. The Brockie-Pell Arc Lamp, Limited, have secured the contract for the supply of the 15-ampere arc lamps for street lighting; 67 lamps have been ordered, and also a supply of spare globes and lamp pillar switches. Messrs. Walter Macfarlane & Co., Glasgow, have supplied a sample lamp pillar, which has been erected, and a sample lamp was put into operation on the night of the Jubilee, and it is expected that the Council will accept Messrs. Macfarlane's tender for the whole of the pillars, at their meeting next week.

Prestwich.—The District Council have published notice that it is their intention to apply to the Board of Trade for a provisional order.

Stoke-on-Trent.—Messrs. Crompton & Co., Limited, have informed the Council that they propose applying for a provisional order, and asking whether the Council would favourably receive that action. The Corporation will oppose the application.

Tynemouth.—The Trade and Commerce Committee presented a report to the Council last week with regard to electric lighting and electrical traction for tramways. The surveyor had obtained information as to the electric lighting of 38 towns, together with the names of the engineers by whom the works had been carried out. The Committee recommended that the services of Mr. Lacey be retained, and that the Borough Surveyor be authorised to visit the towns mentioned by Mr. Lacey.

Wales.—Messrs. Downing & Handcock, solicitors, Cardiff, have given notice of their intention to apply for a provisional order to supply electricity to Llandaff, Llanishen, and Lisvane.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Dublin.—The agreement entered into by the Corporation and the Dublin Tramway Company with respect to the introduction of electric traction into the city contains the following:—"The company shall for forty years from December 31st, 1898, and thereafter, until the exercise of the right of purchase mentioned in the 9th clause hereof pay to the Corporation for and in respect of way-leave over the streets and roads within the said city by the company in respect of the existing tramways, and of the tramways when constructed under the said Electric Bill and proposed Order in Council, the annual sums or rents following, that is to say—to pay at the rate of £500 per year per street mile of tramways for electrical equipment, the minimum yearly rent to be £10,000 per annum, when power is obtained from Parliament to electrically equip the whole or any part of the said existing tramways; first payment one-third of such rent whatever it may be, but not less than one-third of such rent of £10,000 per annum, on December 31st, 1898; one-third on June 30th, 1899, and one-third on December 31st, 1899; and all future payments of the total rent to be by half-yearly payments on June 30th and December 31st in each year, the first payment of such half-yearly rent to be made on June 30th, 1900. It is agreed that the company shall pay the rent at the rate of £500 per year, per street mile, for every street mile of the new lines intended to be constructed, when constructed under the proposed Order in Council, but the company are not to be bound to construct any of the proposed extensions within the city if power be obtained to do so under said proposed Order in Council, save the line for which power of construction is being sought for under the proposed Order in Council, which is to run from the corner of Westland Row, in South Great Brunswick Street, through that street over the drawbridge to Ringsend, but which line is to be constructed by the company if power to construct same be obtained this year, or in any subsequent year, whenever this Corporation shall call upon them in writing to do so. . . . . It is agreed between the company and the Corporation that in the event of the Corporation calling upon the company to introduce any new or improved system of electrical traction in Westmoreland Street, College Green, Grafton Street, and Nassau Street, in lieu of the proposed system, after a period of two years, the company, on getting six months' notice in writing, shall do so. In case any difference shall arise between the company and the Corporation under this paragraph of this agreement, the same shall be settled by the Board of Trade, whose decision shall be final. The Corporation agree to and undertake to assist in having a clause inserted in the Electrical Power Bill, and in any other Bill or order that may hereafter be promoted by the company, to authorise the electrical equipment of all the existing lines of the company, and of those to be constructed under the proposed Order in Council."

Dublin.—It will be remembered that in the laying of the Dublin-Dalkey electric tramway system, the level of one of the Kingstown streets had to be lowered. An action has now been heard by the Lord Chief Baron and a special jury at Dublin which is the result of that occurrence. The action was brought by Mr. Edward Taaffe, who carries on business as a publican and hardware merchant at 50 and 51, Upper George's Street, Kingstown, to recover from the Dublin Southern District Tramways Company compensation for loss and damage suffered by him as a trader in consequence of the alteration made in the levels of the streets and footpaths by the defendants in the construction of the tramway lines. The plaintiff complained that on various days and at divers times in the years 1895 and 1896, the defendant company, and its servants and workmen, wrongfully lowered the road and the footway in front of the plaintiff's premises, thereby obstructing and interfering with access to and egress from the premises, and lessening the support to and impairing the foundations of said premises. The plaintiff alleged that in consequence of these wrongful acts he was injured in his trade and business, and he claimed £2,500 damages as compensation. He also sought an injunction to restrain the defendant company from continuing or repeating the injury. The defendant company denied the acts complained of, and pleaded that under the provisions of the Dublin Southern District Tramways Provisional Order and the Acts of Parliament incorporated with it, they were authorised to alter the levels of the street referred to. They further pleaded that prior to the doing of the acts complained of the management, control, and maintenance of the streets were vested in the Kingstown Commissioners, as the road authority, and that the lowering of the level of the street complained of by the plaihtiff was done under the authority and by the direction of the commissioners. Finally, they pleaded that the acts complained of were done by leave and license and with the knowledge and acquiescence of the plaintiff. The jury, by direction, found for the plaintiff, with 6d. damages. The Lord Chief Baron said that the act of the tramway company in altering the levels of the streets could not be justified either under their Order in Council or as acting under the authority of the Commissioners of Kingstown; and in his opinion they had no right to interfere with the streets in the way they had done. Under the circumstances, however, he would not grant a mandatory injunction to compel them to remove their line, but he would direct an inquiry in the same way as would be done by the Master of the Rolls or the Vice-Chancellor as to the damage sustained by the plaintiff, and he would now formally enter a verdict for the plaintiff for the sum of 6d. He would give every facility for having his direction reviewed in a higher court.

Dundee.—The question of the municipalisation of the tramways came before the Council last week, and was adjourned for a fortnight.

Johannesburg.—It is stated that the Transvaal Volksraad last week threw out the new electric tramway scheme for the Rand. It was held to be against existing vested interests! We have read somewhere that farmers would lose a great deal of forage business if electricity were employed, and this argument is thought to have weighed with the members of the Volksraad.

Leeds.—The work of putting down the plant for the running of electric cars between Roundhay and Kirkstall is proceeding very satisfactorily, and little doubt is now entertained, says the *Leeds Mercury*, that they will be ready for use by August 1st. Indeed, an effort is being made to make a trial trip in a few days. The six miles of double lines along the route are practically complete; the overhead wires have been placed in position; the cars, with their plush-lined seats and easy running bogie carriages, are rapidly nearing completion, whilst the construction of the generating station at Crown Point has so far progressed, that in about a week the power necessary to propel the cars will be available. Messrs. Fowler have been busily engaged erecting the engines all the time building operations have been going on. At the present time the premises are still without roof, and several weeks must elapse before the building is got into ship-shape order. But this will not prevent the generating plant being used. One of the engines—a 400 horse-power compound condenser—has been completed some days. On Saturday last it was set running for a short time. The dynamos have also been tested at the works of Messrs. Greenwood & Batley, at Armley. One of the boilers was used on Saturday, and the other, if necessary, can be got ready in a day or two. These boilers are supplied by Messrs. Clayton, Son & Co., of Hunslet. The water required for them is drawn from the river.

Leith.—The Special Committee of the Town Council, which recently visited several towns in England to inquire into the different systems of tramway traction and electric lighting, is framing a report, which will be submitted to the first meeting of Council in July. As regards tramways, the Committee are stated to be unanimous in favour of electric traction all over Leith from the city boundaries.

TELEGRAPH AND TELEPHONE NOTES.

Argentine Telephone Service.—The Argentine Government has approved a concession which will extend telephonic communication between Monte Video, Buenos Ayres and Rosario, Santa Fé.

Telegraphic Interruptions and Repairs:—

CABLES.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
West Indies—		
Puerto Plata-Martinique	Dec. 19th, 1895 ...	...
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Jamaica-Colon	Feb. 6th, 1897 ...	June 28th, 1897.
Grenada-Trinidad ...	June 2nd, 1897 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Hong Kong-Amoy	June 24th, 1897 ...	...
Foochow-Shanghai	June 24th, 1897 ...	...
Bonny-Cameroon	June 25th, 1897 ...	...
LANDLINES.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Siberian lines—		
Blagowestschensk-Khabarowka.	June 18th, 1897 ...	June 24th, 1897.
Tschita-Stretinskaiia ...	June 23rd, 1897 ...	June 24th, 1897.
Near Tschita	June 26th, 1897 ...	June 27th, 1897.

April 19th, 1897.—Chio-Syra route impracticable.

April 19th, 1897.—During war between Turkey and Greece, cable between Trieste and Corfu cannot be used for messages for Turkey; they must be sent *viâ* Bosnia, Montenegro and Servia.

The Ottoman Government announces that messages in secret language may not be sent to the Greek Minister and Consul in Turkey. They are to be sent in plain language.

April 21st, 1897. — The Greek Administration prohibits secret language for private telegrams for Greece.

April 25th, 1897.—The Hellenic Administration notifies delay on press messages emanating from Greek provinces by reason of the lines being blocked.

May 26th, 1897.—The Ottoman Administration notifies that, until further notice, private telegrams for Crete must be written only in plain Turkish or French language.

June 3rd, 1897.—During the interruption of communication with Trinidad and Demerara telegrams are sent by hired boat. Delay about 24 hours.

June 24th, 1897.—During the interruption between Hong Kong and Shanghai, telegrams for Japan, Corea, Shanghai and Amoy must be sent *viâ* Vladivostock; and telegrams for Hong Kong, Foochow and Formosa *viâ* the Indies.

A Well-Deserved Rebuke.—In our Telegraph Notes we have, on several occasions during the last year or two, had to draw attention to the fact that interruptions in cables and in landlines, of which the Bureau International des Administrations Télégraphiques at Berne should have been advised, have not been reported. This neglect has evidently attracted the attention of Monsieur E. Frey, the Director of the Bureau, as we find in the Berne notification for this month the following paragraph:—"*Notice of Interruptions and Re-establishments of Communication.* Recent facts oblige us to give notice that the Bureau International ought to be informed by telegraph, according to the terms of Art. LXXXII., par. 4 of the Rules, of all the interruptions or re-establishments of communications which affect International traffic. It follows that when an interruption has been announced we should also be advised when the communications have been restored to their normal state." In connection with the above notice, it is interesting to read in the Australian press that on May 14th the Postmaster-General of New South Wales received the following from Adelaide:—"Eucla, 6.15 p.m.:—Perth line interrupted all day beyond Albany. No circuit beyond Balladonia, on the Coolgardie line, between 3.30 p.m. and 6 p.m. The bulk of to-day's business is still in arrears." We received no report of this interruption from the Berne office, which should have been advised; as the Perth line forms the connecting link with the Roebuck Bay-Baujoewangie cable, which, we understand, was laid to carry international traffic during the rather frequent interruptions occurring in the Port Darwin-Baujoewangie cables. In view, however, of the statement made by Sir Thomas Playford, as to the comparative inefficiency of this route, the Government of Western Australia may be, perhaps, excused from reporting the collapses occurring on their line on the grounds that these are not abnormal.

Chess by Cable.—We have received a neat little pamphlet evidently issued by the Anglo-American Telegraph Company, entitled "Parliamentary Chess Match by Cable: the Great Telegraphic Feat." The pamphlet gives full particulars of the game played by members of the British House of Commons *v.* the United States House of Representatives. The match was played over the cable and land systems of the Anglo Company and the Western Union Telegraph Company. The smartest piece of transmission done during the play was London to Washington and back a distance of 8,360 miles, in 13¼ seconds.

Direct Spanish Telegraph Company.—This company announces various alterations in tariffs and rules, as revised at the International Telegraph Conference of Buda Pesth, and which came into force yesterday, July 1st.

Reduction of Telegraph Rates.—The Eastern Extension Telegraph Company notifies that the cable rate between Great Britain and Queensland were yesterday reduced from 9s. 5d. to 5s. 1d. per word, and that substantial reductions were also made in China and Japan tariffs.

Indian Telegraphs.—According to an Indian contemporary, Mr. Melhuish, deputy director-general of the Indian Telegraph Department, was to retire under the 55 years rule on June 24th. The following provisional changes are being made in consequence:—Mr. F. G. Maclean will officiate as deputy director-general, Mr. Larkins succeeding him as temporary director of the construction branch.

CONTRACTS OPEN AND CLOSED.

OPEN.

Birkenhead.—July 20th. The Corporation wants tenders for the wiring and lighting by electricity of the Woodside Ferry. See our "Official Notices."

Dundee.—July 13th. The Gas Commissioners want tenders for a supply of copper strip. City Electrical Engineer, Mr. W. H. Tittensor. See our "Official Notices."

France.—July 13th. Tenders are being invited by the French Post and Telegraph Authorities in Paris for the supply of 755 kilometres of paper-insulated electric cables in 16 lots. Tenders to be sent to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Glasgow.—July 5th. The Corporation want tenders for the supply of (1) copper rods, (2) small cast-iron covers, (3) gun-metal terminals, (4) brass grip-boxes, and (5) stoneware insulators, for the Corporation. Forms of tender and specification obtainable at the office of the Electrical Engineer, 75, Waterloo Street. Tenders to be lodged with Mr. J. D. Marwick, Town Clerk, Glasgow, by July 5th.

Leyton.—July 5th. The District Council want tenders for the supply of stoneware conduits. Electrical Engineer, Mr. H. C. Bishop.

Lincoln.—July 14th. Tenders are being invited for the supply and erection of two dry back marine-type boilers: high-speed engines, continuous current dynamos, steam and other pipes, pumps, motors, and travelling crane; a fuel economiser: storage batteries; a main switchboard and instruments; armoured concentric and triple-concentric cables, and pilot wire cables. Particulars may be obtained at the office of Mr. C. S. Vesey Brown, city electrical engineer, Corporation Offices, Silver Street, Lincoln.

London.—July 8th. The Metropolitan Asylums Board want tenders for the supply and running of mains in the grounds, and for the wiring of the Nurses' Quarters now in course of erection at the North Western Fever Hospital, Haverstock Hill.

Roumania.—August 20th. Tenders are being invited by the General Direction of the Roumanian Posts and Telegraphs in Bucharest for the supply of 55,000 porcelain (double-bell) insulators. Tenders to be directed to the Direction Générale des Postes et des Telegraphes, Bucharest.

Spain. — July 12th. The General Direction of the Spanish Posts and Telegraphs in Madrid is inviting tenders for the supply of 20,000 sheet zinc cylinders. Tenders to La Direccion General des Postes y Telegrafos, Madrid.

St. Helens.—July 20th. The Corporation want tenders for the supply and erection of plant and machinery for electric lighting extensions, including boiler, pump, economiser, alternators, exciters, switchboard, underground work, transformer sub-stations, &c. Consulting engineer, Mr. Robert Hammond.

CLOSED.

Leith.—We understand that the Leith School Board has given Messrs. Cox-Walkers the contract for electrically lighting the Academy at a cost of £1,372 odd.

St. Pancras.—The tender of Messrs. Crompton & Co. for the supply of 100 arc lamps has been accepted by the Vestry, the amount being £799 19s. 8d. The other tenders sent in were from Messrs. Drake & Gorham for the Jandus lamp (£700) and the Brockie-Pell Arc Lamp Co., Limited (£840). The Electric Construction Co. received the order for the switchboard at £70, the other estimate being sent in by the Manchester Edison & Swan Co. (£92).

NOTES.

The Municipal Electrical Association—Manchester Meeting.—On Wednesday this Convention opened with the reading of the President's address, a lengthy abstract of which we publish. About 100 members and friends were present. On the motion of Mr. Arnot, seconded by Mr. Rider, a cordial vote of thanks was accorded to Mr. Wordingham for his address, to several points in which we shall probably devote some critical comments in our next issue.

Mr. Snell was next called upon to read his paper, and this was followed by another on the same subject by Mr. Steinitz. These we publish in another portion of our current issue. A discussion followed, much of which took the shape of our own comments (see page 3).

Mr. Crompton, who pins his faith to water-tube boilers, has no love for the Lancashire type, and he does not consider mechanical coking stokers any advance on good hand firing.

Mr. Raworth discussed in a very able manner the broad question of water tube *v.* Lancashire boilers, and there is little doubt that the latter are good enough for him.

Mr. Kolle and Mr. Norbury were each eloquent on the merits of the Babcock-Wilcox and Galloway boilers respectively, but we would prefer to get direct testimony from users and not from manufacturers.

Mr. Gibbings, Mr. Arnot, Mr. Wilmshurst, Mr. Dolby, Mr. Tremlett Carter, Mr. Robert Hammond, Mr. Andrews, Mr. Geipel, and others took part in the discussion, but perhaps the points at issue were most ably handled by Mr. Crossland, to whose criticisms we hope to refer later.

Mr. Wordingham summed up the *pros* and *cons* very briefly, and sagely expressed his belief that both boilers were good, and that there is a big field for each.

Mr. Snell and Mr. Steinitz having briefly replied, Mr. Gibbings read a short paper on "Municipal Aids to Wiring," but time did not allow of more than a few cursory remarks, and probably the subject will be brought up again at the next meeting.

The members and guests were then entertained at luncheon in the Town Hall by the Manchester Corporation Electricity Committee, and after a reception at the Dickinson Street station, the afternoon was devoted to visits, the party dividing into contingents to the works of S. Z. de Ferranti, Limited, Oldham; Mather & Platt, Salford; Galloway's Limited, Ardwick; Hans Renold, Brook Street; National Telephone Company, Portland Street; General Electric Company, Salford.

In the evening the Association dinner took place, and a large muster of members and friends sat down. The following toasts were proposed and cordially received: "The Municipal Electrical Association" by Mr. Crompton, "The Manchester Electricity Committee" by Mr. Rider, "The Guests" by Mr. Arnot, "The Electrical Manufacturers" by Mr. Gibbings, and "The Press" by Mr. Councillor Pearson of Bristol. These were severally responded to in appropriate terms by Mr. Wordingham, Mr. J. W. Swan, who gave some interesting reminiscences of his labours when engaged in trying to solve the problem of electric lighting as early as 1842, Mr. Ferranti, and Mr. H. Alabaster.

The following papers were down for reading yesterday:—

"Street Lighting by Electricity." Three papers by—H. L. P. Boot, borough electrical engineer, Tunbridge Wells; C. D. Taite, borough electrical engineer, Southport; S. E. Fedden, electricity mains superintendent, Edinburgh.

"Electricity Meters." By T. P. Wilmshurst, borough electrical engineer, Halifax.

"Pre-payment Meters." By H. W. Cousens, borough electrical engineer, Taunton.

Visits were to be paid to the Liverpool electric light station, the Liverpool Overhead Electric Railway, the Liverpool Grain Storage Company, the Chloride Electrical Storage Syndicate, and the Prescot Cable Works.

Personal.—Mr. C. Walmsley has been appointed secretary to the British Electric Traction Company, Limited.

Wireless Telegraphy.—A daily paper says that Signor Marconi has this week been making experiments at Rome at the request of the Italian Minister of Marine. Later information states that the Italian Government has decided to apply the Marconi system to marine telegraphy.

Appointments Vacant.—The Islington Vestry are wanting a canvasser (temporary) in connection with the Electricity Supply Works. See our "Official Notices."

The Leyton District Council want an engineer-in-charge, for the electricity supply station; salary, 35s. per week. See our "Official Notices."

What is an E.L.E. ?—We feel curious to know. We have occasionally seen the appendage "Ass.," &c., to a name, and have more than once, quite pardonably, nodded approval; but when a gentleman's card is put before us, Mr. — — ——, "E.L.E.," we must confess to something more than a nod. We are non-plussed, for E.L.E. might mean so many things. But perhaps it is, after all, only an attempt to dub oneself an electric light engineer in an imposing manner. A correspondent, who sends us a card decorated in this way, suggests that perhaps "E.L.E. is a new degree or a Jubilee honour." There's nothing like being original.

A German Lawsuit.—A libel action which has now for some time excited a great deal of interest in electrical circles, has just been decided at Munich. Oscar von Miller, the well known Munich electrotechnist, brought an action for libel against Karl Cörper, the manager of the electricity works "Helios," at Cologne, on the ground that the defendant had libelled him in the most unqualified manner in a letter to the municipality of the town of Rosenheim. The town of Rosenheim decided, towards the end of 1895, to erect an installation to supply the town with electricity, and called in Oscar von Miller as consulting electrical engineer. Von Miller worked out a scheme, and signed a contract with the municipal authorities, by which he undertook the working out of detailed plans, and the superintendence of the works during erection. Immediately after, he sent out invitations to a large number of firms, amongst them being the defendant's firm, "Helios," of Cologne, asking them to make offers for the erection of the works. Some months after this Von Miller received an intimation from the Town Council of Rosenheim, stating that they wished to cancel the agreement with him, and that the "Helios" firm, of Cologne, had undertaken to complete the work. A letter written by Von Miller to the Town Council criticising the "Helios" scheme was forwarded to Cologne, and elicited from Cörper a reply which contained the libel complained of. Cörper accused Von Miller of acting in the double character of consulting engineer and contractor, and made other calumnious insinuations against his professional and even his moral character. The evidence of the witnesses in court completely failed to substantiate any of these charges, and Von Miller was shown to be an expert of the highest standing and professional character. The charges were decided to be malicious, and due to trade jealousy. The sentence on the defendant was 14 days' imprisonment, since the judge considered that a fine would be no sufficient punishment to a man in the defendant's position.

Long-Distance Transmission of Power.—In American mining of coal there is probably more waste than with us, and huge heaps of slack accumulate at the mines. A power transmission scheme from these waste heaps of something like 20,000 H.P. is projected from the Leavenworth Mines to Kansas City. There is said to be a population of 2½ millions within a 40-mile radius of Leavenworth. The district is thus comparable with that of Manchester, round which city the 40-mile radius includes 7½ millions, or thereabouts. Leavenworth is thus, for a new country, an exceedingly populous centre. Steam is the motive power suggested, engines of 10,000 H.P. being spoken of, and boilers of 5,000 H.P. each. The question is discussed by an American contemporary, which sums the whole matter up to an equation as between, on one side, the carriage and cost of fuel delivered in Kansas City, and, on the other hand, the cost on the spot and the expense of the line. It appears that for carrying coal from Leavenworth to Kansas City, a paltry 25 miles, the charge of the railroad is a dollar per ton—say, 4s. This is stiff, and contradicts one's impressions of American cheap rates. The rate to London from the Nottingham collieries—a distance of, possibly, 125 miles—is, we believe, only about 8s. We think the scheme ought, therefore, to stand a good chance of success; but at 4s. per ton the railway company can afford to drop their rate, and may choke off the new scheme. Should it be carried out, we should recommend gas producers of the blast furnace type to be employed to produce gas for steam raising. They would then enable gas engines to be employed, if needful. The new enterprise proposes harmonious working with the light and power stations existing already in Kansas City.

Resistance of Electrolytes.—*L'Eclairage Electrique* gives an abstract of an article of F. Kohlrausch with regard to the employment of platinised electrodes in the measurement of the resistance of electrolytes. The solution which gives the best results for the platinisation is that employed by MM. Lummer and Kurlbaum in the construction of their bolometers. It consists of 1 part platinic chloride and 0·008 parts of plumbic acetate in 30 parts of water. Such electrodes are said to give very much improved measurements even with comparatively small electrode surfaces. Platinum black is easily moistened by the liquids, so that good contact is ensured, but care has to be taken to wash the electrodes thoroughly after use. The platinum deposit containing lead is less firm than a deposit of pure platinum, but it possesses the advantage of being easily renewed. In making resistance tests, a telephone method is employed; to prevent errors arising from the heating of the liquids by the testing current, the author advises that an extra resistance of about 1,000 ohms should be included in the bridge-arm.

Garden Party.—Last night (July 1st) a garden party was held at Stisted Hall, Braintree, the residence of Mr. James Paxman, J.P., of Davey, Paxman & Co., engineers, Colchester. About 400 guests were expected. A special train left Liverpool Street in the evening, conveying a party of the guests. The drives of the park, as well as the marquees, were illuminated by arc lights.

Copper.—It is stated that a train of eight cars loaded with copper bullion and matte from the Hall Mines left Revelstoke (B.C.) on 28th ult. for Montreal for shipment to England. This is the first consignment of copper from British Columbia. It is rich in silver and gold, the value being about $500 per ton.

Companies v. Municipalities.—Our American namesake says that an unsuccessful attempt was recently made in the Illinois Legislature to pass a law allowing municipalities having their own electric lighting plant to sell the product to private consumers. "This," remarks our contemporary, "is as it should be. No municipality should attempt to compete with private enterprise. It is against the spirit of the times. Where a town has owned its own lighting plant, it has generally been found that the light costs more than in cases where it was the product of private capital. If the rates have not shown such to be the fact, the taxes have. The price of light, like the drummer's overcoat, will be found somewhere in the bill, even if it be re-christened under some such name as 'deficiency appropriation.' Towns and cities had better leave all such business to those who know how to manage it." Such remarks as these are rather strange reading on this side of the Atlantic, where nearly all our provincial electric lighting undertakings are owned and worked by municipalities, and where generally speaking, it has *not* been found that "the electric light costs more than in cases where it was the product of private capital." Our namesake refers to America, whereas we refer to English practice, and that is where the difference comes in.

Brevity the Soul of Wit.—The New York *Electrical Review* is responsible for the following piece of humour:—"The president of an electric railway company complained to his superintendent, a Hibernian named Finnegin, that his daily reports of trouble on the line were too long—too wordy. 'Cut 'em short,' said the busy president. The superintendent's next report of a car off the track satisfied all hands. It was:—

'Offagin.
'Onagin.
'Awayagin.

'Finnegin.'"

The Pender Memorial.—It is announced that a public meeting will be held to-day, Friday, at 4 o'clock p.m., at the University College, Gower Street, to inaugurate the personal memorial to the late Sir John Pender, Mr. Onslow Ford's bust of whom will be on view, and a cheque for £5,000 to endow the electrical laboratory of University College will be handed over to the trustees. The Marquis of Tweeddale will preside, and Lord Kelvin is expected to be present and speak.

Paris and Electric Railways.—After many delays, Paris is now within reasonable distance, says the *Pall Mall* Paris correspondent, of being provided with the Metropolitan railway. The Municipal Council has gained its principal points—namely, that the railway is to be under autonomous management, to be of narrow gauge, with electric traction, constructed by the City Board of Works, and run by a private company, to which the concession will be made over. The construction of the line between Courcelles and the Champs de Mars had already been conceded by the Government to the Western Railway of France. There was a great deal of fuss about it; but the Municipal Council has now withdrawn its objection to the division of the labour, on condition of being allowed to commence its own operations without hindrance. The first line will pass from the Porte de Vincennes to the Porte Dauphine, in a slanting line through the centre of Paris from N.W. to S.E. There will be a circular line parallel with the exterior boulevard, connecting all the interior lines, a line N.W. to N.E., from Porte Maillot to Menilmontant, and connecting lines from the Porte Clignancourt to the Porte d'Orleans from the Boulevard Strasbourg (N. to S.) to the Pont d'Austerlitz, and from the Cours de Vincennes to the Place d'Italie (E. to S.). The cost is estimated at 165,000,000 francs (£6,600,000), and beyond this the Municipal Council is not authorised to go. Two other central lines are in contemplation, one starting from the Palais Royal with stations in the districts of the Place du Danube, the Place de l'Opera, the Rues Lafayette and Chabrol, the Eastern Railway terminus, the round-point of La Villette, the Buttes Chaumont, and the Rue La Vilette. This would bring the N.E. into direct communication with the centre, connect the great eastern and western termini, and bring the Place de la Bastille into communication with St. Lazare and the Batignolles. The other, starting from the Opera, would connect the centre with Auteuil, Grenelle, and Gros-Caillou. The last-named would involve a double passage across the Seine precisely in places where the ground is least favourable for bridge construction or tunnelling.

NEW COMPANIES REGISTERED.

Cork Electric Tramways and Lighting Company, Limited (2,103).—Registered in Dublin June 18th with a capital of £140,000, in 7,000 preference shares of £10 each, to promote, obtain, or acquire the necessary authority to make and maintain tramways or railways in the city and county of Cork or elsewhere in the United Kingdom, with such extensions and deviation as may from time to time be agreed upon. The subscribers (with one share each) are:—W. M. Murphy, 39, Dame Street, Dublin, J.P.; W. Carte, Military Road, Dublin, J.P.; J. F. Lombard, South Hill, Upper Rathmines, Dublin, J.P; J. J. O'Connor, 21, Lower Sackville Street, Dublin, merchant; B. Anderson, Glenavon, Merrion Road, Dublin, J.P.; J. Fitzgerald Murphy, Dartry, Rathmines, barrister; M. Lombard, 25, Rathgar Road, Dublin, gentleman; F. W. Brady, 26, Upper Pembroke Street, Dublin, bart. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first. Qualification £500; remuneration as fixed by the company. Registered office, 29, Dame Street, Dublin; registered by W. H. Briggs, 39, Dame Street, Dublin.

Safety Motor Syndicate, Limited (53,062).—Registered June 21st with capital £1,500 in £1 shares to manufacture, sell, and deal in motors, steam, oil, gas, water, air, electrical, and other engines, dynamos, and machines, and to carry on the business of mechanical engineers, tool makers, founders, boiler makers, tube makers, millwrights, &c. The subscribers (with one share each) are:—C. H. Underwood, 14, Hargwyne Street, Brixton, clerk; J. E. Tatnell, 207, Gladstone Avenue, Wood Green, clerk; S. W. H. Dixon, Briar Cottage, Walton-on-Thames, journalist; J. C. Hunting, 56, Priory Road, N.W, advertising contractor; A. K. Haseldene, 143, Abbey Road, N.W., clerk; R. C. C. Balfour, 50, Mervan Road, Brixton, bookkeeper; A. W. Marks, 49A, Lincoln Inn Fields, W.C., solicitor. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; remuneration as fixed by the company. Registered office 49A, Lincoln Inn Fields, W.C.

Midland Electric Corporation for Power Distribution, Limited (53,071).—Registered June 23rd with capital £200,000 in £5 shares, to carry on in the United Kingdom and elsewhere the business of an electric light and power company in all its branches, and to acquire, construct, equip, work and manage tramways, railways, and other methods of using electrical energy. The subscribers (with one share each) are:—J. F. Albright, Mansion House Buildings, E.C., civil engineer; T. Parker, Wednesfield Street, Wolverhampton, engineer; G. L. Addenbrooke, 21, Lichfield Street, Wolverhampton, engineer; T. O. Callender, 90, Cannon Street, E.C., engineer; F. R. Reeves, Lochleven House, East Finchley, engineer; R. Daud, Mansion House Buildings, E.C., clerk; E. H. F. Reeves, Lochleven House, East Finchley, gentleman. The number of directors is not to be less than four nor more than seven; the subscribers are to appoint the first; qualification £1,000; remuneration £150 each per annum (£300 for chairman), and a share in the profits. Registered by E. Reeves, 4, Queen Victoria Street, E.C.

Central Electric Supply Company, Limited (53,080). Registered June 24th, with capital of £100,000 in £5 shares, to carry on the business of electrical engineers, electricians, suppliers of electricity, electric apparatus manufacturers, and mechanical and chemical engineers. The subscribers (with one share each) are: J. Renwick, 29, Hillside Road, Stamford Hill, N., clerk; H. J. Tiddeman, 52, Kenning Hall Road, Clapton, solicitor; M. E. Sheerbourn, 6, Ferncliff Road, Dalston, N.E., clerk; A. Jones, 22, Solon Road, Brixton, S.W., clerk; A. M. Rickards, 55, Albert Street, Regent's Park, N.W., solicitor; A. Barrenger, 10, Calabria Road, N., clerk; H. J. Page, 1, Gorleston Villas, East Dulwich, accountant. The number of directors is not to be less than three, nor more than seven. The subscribers are to appoint the first; qualification, £250; remuneration as the company may decide. Registered office, Broadway House, Westminster.

Marylebone Electric Supply Company, Limited (53,081).—Registered June 24th with capital of £100,000 in £5 shares to carry on the business of electrical engineers, electricians, suppliers of electricity, and mechanical and chemical engineers, and electrical apparatus manufacturers. The subscribers (with one share each) are:—E. J. A. Balfour, 32, Addison Road, W., architect; L. C. Clark, C.E., 11, Victoria Street, Westminster, S.W.; W. Leaf, 6, Sussex Place, Regent's Park, bank director; J. H. Morris, K.C.S.I., 88, Queen's Gate, S.W.; B. Fitch, M.I.C.E., Grange Road, Ealing, W.; F. J. Walker, 180, Portsdown Road, Maida Vale, W., secretary; S. Dobson, C.E., 5, Westbury Road, Ealing, W. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first. Qualification £500; remuneration £1,000 per annum, or 10 per cent. of the net profits dividend. Registered office, 99, Cheapside, E.C.

Ryde Electric Light and Power Company Limited (53,086).—Registered June 24th, with capital of £10,000, in £5 shares, to carry on the business of electrical engineers, electricians, practical engineeers and contractors, electrical apparatus manufacturers, suppliers of electricity. The subscribers (with one share each) are:—H. N. Adams, 3, High Street, Ryde, I.W., grocer; F. E. Gripper, 19, Great George Street, S.W., electrical engineer; J. C. Wigham, Albany House Monkstown, County Dublin, electrician; A. Gibson, Coromandel, Ryde, boot dealer; H. J. Read, Liverpool Road, St. Albans, engineer; C. W. Jackman, 63, High Street, Ryde, tailor; W. T. Pressland, Westcott, near Dorking. The number of directors is not to be less than three, nor more than seven; the subscribers to appoint the first. Qualification one share; remuneration as fixed by the company. Registered by Clarkson & Toovey, 98, Great Tower Street, E.C.

O'Brien-Lennard Electrical Installation Company, Limited (53,095).—Registered June 25th, with capital £5,000 in £1 shares, to acquire the business carried on by the "Electrical Installation Company, Limited," and that carried on as "late Russell and Lennard," to adopt certain agreements, and to carry on the business of electrical, mechanical, and hydraulic engineers. The subscribers (with one share each) are: J. G. O'Brien, captain, 42, Wimpole Street, W.; E. L. O'Brien, 45, Chester Square, S.W., electrical engineer; L. Grant, 369, Hoe Street, Walthamstow, engineer; C. W. Voltaire, Bickersteth Road, Tooting, clerk; R. F. B. Lennard, 2, Foulis Terrace, S.W., electrical engineer; Mrs. R. F. B. Lennard, 2, Foulis Terrace, S.W.; Mrs. E. L. O'Brien, 45, Chester Square, S.W. The number of directors is not to be less than three, nor more than five. The first are R. F. B. Lennard, J. G. O'Brien, and E. L. O'Brien. Qualification, £100; remuneration, 10 per cent. of the net profits after the payment of the preference dividend. Registered by J. C. Wheeler, 6, New Inn, Strand.

Phaeton Electrical Company, Limited (53,101).—Registered June 26th, with capital £1,000, in £5 shares, to act as agents to the U.K. of the Electriciteits Maatschappij Phaeton of Nijmegen, Holland, and to manufacture, sell and deal in electric lamps, bells and other apparatus. The subscribers (with one share each) are:—E. Simmonds, 36, Finsbury Circus, solicitor; J. K. Kempees, Nijmegen, Holland, inspector; F. Thyssen, Nijmegen, wood merchant; J. J. M. Everts, Nijmegen, Holland, director; J. P. Roothaan, Brussels, director; C. Alewijnse, Nijnegen, Holland, director; C. M. V. Roothaan, Nijmegen, Holland, director. The number of directors is not to be less than three, nor more than six; the first are:—C. Alewijnse, C. M. V. Roothaan, J. P. Roothaan, and H. Schuurman. Qualification one share; remuneration as fixed by the company. Registered by Emanuel & Simmonds, 36, Finsbury Circus, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Gorseinon Electric Light Company, Limited (39,944). This company's annual return was filed on April 13th, when the capital of £1,000, in £1 shares, was fully taken up; 16s. per share has been called and £788 has been paid, while £12 has yet to be brought in.

Indo-European Telegraph Company, Limited (3,953).—This company's annual return was filed on May 18th, when 17,000 shares were taken up and paid for in full out of a capital of £450,000 in 18,000 shares of £25 each.

CITY NOTES.

United River Plate Telephone Company, Limited.

The report of the directors to be presented to the shareholders at the eleventh ordinary general meeting, to be held at Winchester House, 50, Old Broad Street, London, E.C., on Tuesday, July 6th, 1897, at 12 o'clock noon, states that the directors have pleasure in submitting to the shareholders the accompanying balance-sheet and profit and loss account, showing the result of the company's operations during the year ending March 31st last. The gross receipts in sterling for the year in the River Plate were £60,325 6s. 5d., as against £48,744 10s. for the year before, and the working expenses in the River Plate £30,204 14s. 2d., as against £24,967 2s. 2d., leaving a profit, after the deduction of debenture interest and all London charges less transfer fees and interest on investments, of £20,552, as against £14,504 13s. 7d., to which should be added £4,524 5s. 11d. brought forward from the previous year, making an available balance of £25,076 5s. 11d. Out of this sum the directors propose to transfer £3,000 to depreciation fund, and they recommend that a dividend of 5 per cent., free of income-tax, as against 4 per cent. last year, be paid upon the ordinary share capital of the company, and that the balance of £7,576 5s. 11d. be carried forward. The capital outlay was £4,647 4s. 8d., as compared with £2,682 3s. 9d. last year. The increase in the business of the company has fully met the anticipations of the directors, and further steady improvement is confidently expected. Under the articles of association, Mr. George Cooper and Mr. Alfred Le Rossignol retire, and offer themselves for re-election. The auditors, Messrs. Welton, Jones & Co., also offer themselves for re-election.

South Staffordshire Tramways Company, Limited.

An extraordinary general meeting was held on Monday, at Cannon Street Hotel, to consider the terms of an agreement for the settlement of the claims of the Electric Construction Corporation against this company.

Mr. W. Somers Schuster presided, and in moving that the agreement be confirmed, alluded to the financial position of the company at the time the present board came into office, and remarked that, in addition to the difficulty of accrued interest in arrear, they had to deal with various legal and other questions for which they were themselves in no way responsible. Had the company gone into liquidation, there could be little doubt but that the ordinary and preference shareholders would have been wiped out entirely. He could assure them that the terms of the agreement were the best for the company that the directors could secure.

The motion was duly seconded and agreed to, after which a resolution was passed authorising the board to pay the costs and charges properly incurred by the shareholders' protection committee incidental to the legal proceedings, to which the committee were parties, in connection with the steps taken to procure the removal of former directors of the company, and generally with reference to its affairs.

The seventh annual general meeting was afterwards held.

Mr. Schuster again presided, and moved the adoption of the report, which showed that the total receipts for the year amounted to £32,725, an increase on the previous year of £3,058. The total expenditure for the 12 months was £1,734 more than in the corresponding period. Owing to the many difficulties the directors had had to contend with, they considered that the profit of £3,387 on revenue account, as compared with £2,063 in 1895, might be regarded as satisfactory.

Mr. S. R. Blundstone having seconded the motion, the report was adopted.

Thomas Parker, Limited.

The directors' report states that after writing off various depreciations, the balance standing to the credit of profit and loss account is £5,227 2s. 9d. Out of this the directors propose to pay a dividend at the rate of 7 per cent. per annum, less income-tax, amounting to £4,059 8s. 7d., and to carry forward to next year the balance of £1,167 14s. 2d. During the past year the works have been kept full of orders, and to meet the growing requirements of the trade, the fitting shop has been increased by an area of 15,000 square feet. A large addition of tools has been made, and mess rooms have been added to increase the comfort of the workpeople. The directors propose to call up the balance of uncalled capital before the end of the year, and shareholders will be invited to pay up the amounts for which they are liable at an earlier date, if they choose. The director who retires by rotation is Mr. C. T. Mander, who is eligible and offers himself for re-election. The auditors, Messrs. Allen, Edwards & Smith, also retire, but are eligible and offer themselves for re-election.

Woodhouse and Rawson United, Limited.

The Official Receiver and Liquidator of the above company (Mr. G. S. Barnes), in giving notice of his intention to apply to the Board of Trade for release, reports as follows:—"The figures appearing in the statement of affairs submitted by the directors have proved, as regards the assets, to be quite unreliable. The amount realised by the Receiver for debenture-holders, by whom the assets have been entirely administered, is at present £104,320 1s. 3d., and a further sum of £11,000 is expected to be recovered. As the liabilities on debentures amount to at least upwards of £166,000, it is clear that there is no prospect of a surplus for the unsecured creditors or the shareholders. A public examination of the directors and officers of the company was held, in the course of which the manner of the company's formation and the conduct of its business were exhaustively inquired into. A case based on the evidence so obtained was subsequently submitted to counsel, who advised that claims for a large amount, in respect of dividends improperly paid and otherwise, could be enforced against certain directors and officers of the company. The facts were then submitted to the debenture-holders, to whom the benefit of such claims accrued in the first instance; but they declined to allow the funds in the debenture action to be employed in instituting proceedings for recovery. In the result, there being no funds available to enforce the claims from any other source, the claims were sold, by the order of the court, for a nominal sum to two debenture-holders in their individual capacity, and were subsequently compromised by them for an insignificant sum. The Official Receiver and committee of inspection regard this result as very regrettable in view of all the circumstances of the case."

Electrical Power Storage Company, Limited.

The report of the directors, to be presented to the meeting to be held on Thursday, July 8th, 1897, at 4, Great Winchester Street, E.C., at 12.30 p.m., reads as follows:—"The directors beg to present to the shareholders the report and accounts to May 31st, 1897. The net profit for the year is £4,141 5s. 5d., which, with a balance of £343 19s. 7d. from last year, amounts to £4,485 5s., out of which the directors recommend the payment of a dividend of 5 per cent. on the ordinary share capital, which will absorb £4,243 4s. 10d., leaving £242 0s. 2d. to be carried forward. Provision has been made for the maintenance of buildings, plant, tools, &c., at a cost of £2,048 15s. 2d.

"The arrangements for the manufacture of the new Faure-King cell are being rapidly pressed forward, and large orders are being obtained for this new class of goods. The company will shortly be in a position to manufacture and supply storage batteries to any specification embodying known types. The increased demand for the storage batteries of the company's manufacture has necessitated additional accommodation, and premises adjacent to the company's Millwall works, having an area of about 16,000 square feet, have accordingly been acquired on favourable terms.

"For the purpose of providing the necessary capital, which the increase of the company's business and the equipment of the new premises renders necessary, an issue of debentures to the amount of £30,000, bearing interest at the rate of 5 per cent., has been authorised.

"The retiring director is Mr. Frederick Green, who offers himself for re-election. The auditors, Messrs. James Meston & Co., chartered accountants, also offer themselves for re-election."

Elmore's Germany and Austro-Hungarian Metal Company, Limited.—A correspondent of the financial papers says "The decision to reduce the capital of Elmore's German and Austro-Hungarian Metal Company is probably a wise one, but the shareholders should totally oppose the proposed method of applying the reduction and the extension of the exceptional rights of the preference shareholders. Proxies should not be given, but the shareholders should attend the meeting to hear what is said, and vote accordingly."

The Charing Cross and Strand Electricity Supply Corporation, Limited.—The coupons on the 5 per cent. debentures of the above corporation, numbered 1 to 700, due on July 1st next, will be paid on and after that date at the Union Bank of London, Charing Cross Branch, Charing Cross.

The City of London Electric Lighting Company, Limited.—The board on Wednesday declared an interim dividend on the preference shares at the rate of 6 per cent. per annum for the half-year ending June 30th, 1897, payable on and after July 19th next. The warrants for interest due yesterday on the £400,000 5 per cent. debenture stock have been posted.

Metropolitan Electric Supply Company, Limited.—The transfer registers of the new ordinary shares will be closed from 1st to 15th inst., both days inclusive, for payment of the 4 per cent. interest.

Madeira Electric Lighting Company, Limited.—The coupons for debenture interest due June 30th, will be paid on and after that date by the Halifax Joint Stock Bank, Princess Street, Halifax.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending June 27th, 1897, were £1,337; week ending June 28th, 1896, £891; increase, £446; total receipts for half-year, 1897, £26,645; corresponding period, 1896, £24,069; increase, £2,576.

The Liverpool Overhead Railway Company. The receipts for the week ending June 27th, 1897, amounted to £1,716; corresponding week last year, £1,219; increase, £497.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending June 25th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,070.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, June 23rd.	Closing Quotation, June 30th.	Business done during week ended June 30th, 1897. Highest.	Lowest
149,900£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	5 — 6	5 — 6	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	52 — 55	54 — 57	56	54
3,038,020	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	98 — 99	100 — 101	101	98¾
3,038,920	Do. do. Defd.	Stock	...	...	...	9½ — 10	10½ — 11	10⅞	9⅞
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	15 — 15½	14¾ — 15½xd	15	...
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	114 —118	113 —117 xd	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	...	3¼ — 3⅜	3¼ — 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	173 —177	170 —175 xd	...	...
400,000£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	104 —105	106 —107 xd	106⅝	105
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	⅜ — ⅝	⅜ — ⅝	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	9 — 10	9 — 10	9⅜	9⅝
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½ — 4½	3½ — 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9½ — 10½	9½ — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	4½%	105 —108 %	103 —106%xd	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	9½ — 9⅝	9 — 9⅛	9⅜	9 7/16
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17 — 17½	17 — 17½	17⅜	17½
70,000	Do. 6 % Cum. Pref.	10	6 %	6	...	18 — 19	18 — 19	18⅜	...
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	103 —106	103 —106	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	128 —131	128 —131	128½	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7⅛	17⅜ — 18¼	17⅜ — 18¼	18¼	17⅜
35,500	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5%	101 — 105	101 —105	...	...
133,100	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5%	102 —105	102 —105	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	129 —132	129 —132	131½	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5%	101 —105	101 —105	...	...
69,200	Do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4%	105 —108	105 —108	107	105½
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	107 —110 %	107 —110%	108½	108
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½ — 11⅝	11½ — 11⅝	11⅝	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	17 — 17½	17 — 17½	17¼	17⅛
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	10 %	10%	25 — 26	25 — 26	25⅝	25⅛
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5%	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10%	54 — 57	54 — 57	55	54½
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6%	107 —110	107 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2¼	2 — 2¼	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5¼%	6⅝ — 6⅞	6⅝ — 6⅞	6⅞	6⅝
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6¼	6 — 6¼	6¼	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —109	103 —107 xd	108½	106½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4½%	5 %	5 %	⅝ — ¾	⅝ — ¾	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	106 —109 xd	...	...
11,839	Reuter's Ltd.	8	nil	5 %	5 %	7 — 8	7 — 8	7⅛	...
3,381	Submarine Cables Trust	Cert	...	...	...	135 —140	135 —140	...	...
58,000	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3½ — 4	3¾ - 4¼	4	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	100 —105	98 —103 xd	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	nil	4 %	nil	5 — 6	5 — 6	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	101 —104	101 —104	...	...
64,256	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	2 %	8 — 8½	8 — 8½	...	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½ — 7	6½ — 7	...	...
33,129	Do. do. do. Def. Ord	7½	1 %	1 %	...	1¾ — 2¼	1¾ — 2¼	...	...
382,230	Do. do. do. 4 % Deb. Stock Red....	Stock	...	...	...	99 —102	98 —101 xd	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	1 %	⅛ — 1⅛	⅛ — 1⅛	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10½ — 11	10½ — 11	10¾	10½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	107 —110	105 —108 xd	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7%	104 —108	104 —108	...	...
162,200£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6%	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	13 — 14	13 — 14	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6½ — 6⅝	6½ — 6⅝	6½	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	9⅜ — 10¼	9⅜ — 10¼xd	10	9⅞
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	4½%	4½%	112 —115	110 —113 xd	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	23½ — 24½	23½ — 24½	24	23⅝
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 — 18	17 — 18	17 9/16	17⅛
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —136	129 —131 xd	132½	131
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	nil	nil	12⅜ — 13½	12⅜ — 13½	12 13/16	...
10,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	6 %	6 %	15 — 15½	15 — 15½	15½	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	14⅜ — 15½	14⅜ — 15½	...	...
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...	...	8½ — 9	8½ — 9	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	3 %	4 %	5 %	16½ — 17½	16½ — 17⅛	17⅜	17
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem. ...	10	...	...	...	13½ — 14½	16 — 17	...	...
220,000	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	120 —124	118 —122 xd	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	15 — 16	15 — 16	15½	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	15½ — 16½	15½ — 16½	16⅝	16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	104 —107	102 —105 xd	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	5 %	7 %	9 %	15 — 16	15 — 16	16	15⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES - *Continued*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation June 29rd.	Closing Quotation, June 30th.	Business done during week ended June 30th, 1897. Highest.	Lowest.
20,000	British Electric Traction	10	...	...	...	... ...	12 — 12½	...	...
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	3	2½%	...	...	1⅛— 1⅜	1⅛— 1⅜	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1⅛— 1⅜	1⅛— 1⅜	1⅛	...
125,000	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	...	...	105 —109	105 —109	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	95 — 99	93 — 97 xd	...	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	9⅜— 10⅛xd	...	...
143,106	Do. do. do. £6 paid	10	...	...	...	5⅜— 6⅛	5⅜— 6⅛xd	6	...
51,951	Do. do. Pref half-shares £1 pd. ...	...	...	...	...	1⅛— 1⅜	1⅛— 1⅜xd	...	...
54,521	Do. do. Def. do. £5 pd. ...	...	...	...	...	4⅛— 4⅜	4⅛— 4⅜xd	...	...
630,000	City and South London Railway	Stock	1⅛%	1⅛%	1⅛%	58 — 60	59 — 61	60⅜	59⅛
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1⅜— 2⅛	1⅜— 2⅛	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	2⅛— 2⅜	2⅛— 2⅜	2⅜	2⅛
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	3⅛— 4⅛	3⅛— 4⅛	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	4½%	4½%	...	105 —110	103 —108 xd	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	...	1⅝— 1⅞	1⅞ — 2	1⅞	...
16,343	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2⅜— 3⅛	2⅜— 3⅛	3⅛	3⅛
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	¾— 1	¾— 1	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ..	2	*nil*	...	...	⅜— ⅝	½— ¾	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	11 — 13	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	18½— 19½	19 — 20	19½	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	108 —113	108 —113	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	20½— 21½	20½— 21½	21¼	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	104 —107	105 —108	...	...
37,500	Liverpool Overhead Railway, Ord.	10	1½%	2½%	2½%	12⅜— 12⅝	12½— 12⅝	...	...
10,000	Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15½— 16	15½— 16	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	36 — 39	37 — 40	...	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	103 —106	104 —107	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £8 paid ...	10	...	...	...	10⅜— 11⅛	10⅜— 11⅛xd	10⅞	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50 % for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9⅛.

Electric Construction Corporation, 6 % Debentures, 105—108.

House-to-House Company, 7 % Preference, of £5, 10¼—10⅜.

Do. do. 4½% Debentures of £100, 109—111.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 13—13½; 1st Preference Cumulative 6 %, £5 (fully paid), 8—8¼. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 1⅞—2⅛.

Yorkshire House-to-House Electricity Company. £5 Ordinary Shares fully paid, 8¼—8⅜. Dividend for 1896—6 %.

Bank rate of discount, 2 per cent. (May 13th, 1897).

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1897.

"THE GENERATION OF STEAM."* By JOHN F. C. SNELL, Assoc.M.Inst.C.E., Assoc.M.Inst.Mech.E., M.Inst.E.E.

FEW matters can be of more importance to a central station engineer than the means by which steam is raised in his station. The selection of the type of boiler, the proper treatment of the feed water, the method of firing, the general economy of the steam-raising appliances, and the upkeep of the plant, are all factors which engage the serious attention of the designer.

The object of this paper is to bring before you the types of boilers in use and details in connection with them, so that they may be discussed to our mutual advantage.

In Table I., figures of the four types with which we have to deal have been tabulated, viz.:—

I. Lancashire.
II. Water-tube.
III. Dryback Marine or "Economic."
IV. Marine.

From which will be obtained the evaporation, floor space, and approximate cost per 1,000 lbs. evaporated and other data. It will be an advantage to take the types *seriatim*.

LANCASHIRE.—A Lancashire boiler takes 69 square feet of floor space, and costs, erected, £76 without, and £99 with, an economiser per 1,000 lbs. maximum evaporation. The average pressure is from 120 to 150 lbs.; but there are many in use working at 200 lbs. pressure. A Lancashire boiler cannot be considered complete without an economiser in series with it, for the temperature of the exit gases not infrequently exceeds 600°, whereas after leaving the economiser, the temperature is reduced to about 300°. The advantages may be claimed to be:—large steam space, with dry steam, accessibility for inspection and cleaning, and small cost of repairs. The disadvantages are:—the length of time required to get a cold boiler under steam, waste of water while warming up, which usually obtains, and (though only very occasionally) collapse of flues when improperly cleaned, or when fed from the hot well of a surface condenser. The loss of water during warming up can be got over by the use of a hydro-kineter in lieu of the barbarous method of running water out of the blow-off.

This boiler is very generally favoured, and certainly, in the author's opinion, is hard to beat. It is economical, both in evaporative duty and in cleaning; in the latter item probably the cheapest of all boilers. After having had charge of six of this type, the author has found that a 30 feet × 7 feet 6 inches costs about £9 per annum for flue cleaning and inside cleaning. This figure does not include regrinding of any valves, or repairs to fittings, but solely the cost of the boiler cleaning. At the same time it can be forced to burn over 30 lbs. of coal per square foot of grate area if needed, though of course with a decrease in the evaporation per pound of coal. It also can be economically worked by either hand-firing or mechanical stoking. In line "I." of the table, the evaporation was 12·46 from and 112° F. with mechanical stokers, and in line "II.," 11·76 hand-fired, at rather a quicker rate of combustion. A well-known authority, Hutton, on "Steam Boiler Construction," gives the average life of a Lancashire boiler at 33 years.

WATER-TUBE.—This has for its chief advantage small floor space, the space required being 34·4 square feet, and the approximate cost, erected, £96 per 1,000 lbs. evaporation. It is a quick steam raiser, and greater safety at high pressure is also claimed.

The disadvantages usually advanced are:—Small steam space, wetness of steam, frequent repairs to firebrick lining and costliness in cleaning. The author has had to deal with over a dozen of these, and certainly believes in the advantages enumerated, and does not think that steam will be necessarily wet, if steam receivers are added to the drum; also, if the firebrick lining be tied into the brickwork here and there, the bulging is much reduced, and the lining does not fall in. The cleaning is certainly a costly business comparatively; but presumably this type would only be adopted where the water is either naturally soft, or is treated before entering the boiler, thereby allowing the boiler to steam for longer periods.

It is of the greatest importance that steam should be able to be raised quickly in a stand-by boiler, and a water-tube is certainly the quickest steaming boiler, and probably the safest in such a case. There is probably more fuel required to keep this boiler up to pressure when standing by than is required by a Lancashire. It is more difficult to keep an even steam line, and a fireman needs to be specially used to this type. It is economical in evaporation, and the temperature of the exit gases is often as low as 250° F., when not fired too hard, which means a high efficiency. The cost of cleaning a boiler, evaporating, say 5,000 lbs. per hour maximum, with a fairly soft feed, may be taken at £24 12s. per annum, including cleaning of flues, scraping tubes, repairs to firebrick lining, and occasional replace of a tube. Hutton gives the average life as being 15 years only, but it is presumed this only applies to the tubes, and the drum and headers should be as long lived as any Lancashire or other type of boiler.

* Read at Manchester, June 30th, 1897.

"Economic."—This boiler has been adopted in many stations, especially in London, from the comparatively small floor space, combined with small headroom required; it requires 34·4 square feet floor space, and costs about £94 per 1,000 lbs. evaporated. It is also a quick steam-raiser, and to some extent combines the advantages of both Lancashire and marine boilers. The treatment of the feed water is as necessary in this case as in a water tube, unless naturally soft; as for that, this is equally important whatever the type of boiler be. The addition of a hydro-kineter to warm up the water under the flue tubes should be made, though this boiler is better situated than a marine in this respect; the author would expect to find that a greater number of British thermal units are utilised with this boiler on account of the prolonged contact of the gases with the boiler, and therefore the boiler is highly efficient. It must be more costly to clean than either Lancashire or marine boiler adapted for land service.

The author is indebted to Mr. Llewellyn Foster, A.M.I.C.E., the resident engineer of the Davies Street Station, Westminster Company, for the following information as to upkeep and cost of cleaning.

The cleaning cost about £20 per boiler per annum when worked hard and with fairly hard feed water, and the upkeep about ⅗ths of a penny per unit generated.

Marine.—This type has been adopted in some provincial stations. It requires only about 25 square feet of floor space, and costs about £100 per 1,000 lbs. evaporated, when not forced.

Personally, the author does not consider it to be so efficient as the last-named, on account of the setting and arrangement of the flues; stop, and blow-off valves and scum cocks tight; and it is surprising how much can be saved by attention to these points, both in water and fuel.

At Sunderland, the Lancashire boilers are laid off every five or six weeks, and the combined dead-weight and low water valve, the spring safety valve, feed checks, blow-off valve and scum cock, are taken off and thoroughly set up at least every other time; and the author believes it pays to do this. The smallest escape through a blow-off valve or scum cock or a small escape of steam through the stop valve when standing; or again, an escape from a float low-water valve (and this type of valve is much given to this) means considerable increase perhaps, to one's coal and water bill.

Another point which is frequently not attended to is the inspection of the boiler during construction. The author thinks it advisable that the station engineer should do this, and test his own sample strips, or be present at the tests. The boiler-makers would themselves also probably appreciate and prefer this. Again, the author has known several cases in which a simple hydraulic test has been made without any gauging of flues or flat surfaces; that is only a half-test, and, of course, gives no indication of any deformation or set which may have resulted under the stress. An evaporative trial of each boiler should be insisted upon, or of at least one of several similar boilers installed, and is, of course, generally done.

Another saving may be effected by the shutting off of boilers as quickly as possible on a decreasing load. The "stand-by" losses cannot differ very largely in either type of boiler, the Lancashire though having a large volume of water to raise in temperature, after

	TYPE OF BOILER.	1 Floor space.	2 Grate area.	3 Heat surface.	4 Lbs. of coal per square foot grate.	5 Evaporation per lb. of coal.	6 Evaporation from and at 212° F.	7 Total evaporation per hour.	8 Temperature feed.	9 Chimney draught.	10 Temperature flue. Gases exit.	11 Steam press. gauge.	12 Kind of coal.	13 Calorific value.	14 Approximate cost per 1,000 lbs. evaporated.	15 Depreciation per annum.	16 Floor space per 1,000 lbs. Max. evaporation.	17 Fuel per hour, standby.
1	Lancashire Vicar's stoker 96 tube economiser	11·3′ by 32·5′	21	936	16·8	10 7	12·46	3,760	202°	0·6″	473°	120	...	...	£99	5%	90 (with economiser)	24lbs.
2	Lancashire Without economiser Hand fired	11·5′ by 35′	22·5	1,000	23·6	10·08	11·76	5,363	42·4°	0·75″	435°	125	Best Welsh	...	£76	3%	69	...
3	Babcock & Wilcox	25	25	...	13·44	10 73	11·52	2,606	156°	...	...	...	Scotch coal	...	...	...	...	...
4	" "	...	15·5	983	20 9	9 02	10 82	3,915	66°	·317	519°	155	...	...	£96	7%	...	...
5	" "	23′ by 7′ 9″	30	1,619	15·6	9·74	11·9	5,160	48°	·301	285°	173 5	Nixon's navigation.	14,400	...	...	34·4	35
6	Marine Single ended Two furnaces	12·5′ by 11′	42	1,480	22·4	9·15	10·63	8,616	106°	0·86	452°	165	...	14,830	£100	6%	16 0	...
7	Economic	14·5″ by 11·5″	30	1,006	17	...	9·5	4,845	204°	...	...	155	Small Welsh	...	£94	6%	34·4	...

on the other hand it requires no brickwork, is easily inspected on the exterior, and is very neat in appearance. The addition of the hydro-kineter as in the last-named, also applies, and is even more necessary. The cost of cleaning may be taken at about £18 per annum. The average life of the boiler may be taken at 18 years.

The locomotive boiler is not dealt with, because, although an excellent boiler on the railroad, it does not find much favour, in large sizes, for station work, and requires so much room to withdraw the tubes.

To summarise the results of the table, the water-tube boiler takes up the least floor space, per 1,000 lbs. evaporated (except the marine), and costs most for cleaning, and is said to have the shortest life.

The Lancashire type requires the greatest floor space, and costs least for cleaning; and is known to have a very long life.

Either type is now built for the extra high pressures, though the water-tube would probably cause the least destruction in the event of an explosion. The water-tube is the quickest steamer; and the Lancashire probably the slowest; but certainly gives driest steam. Either type can be fired with any variety of coal, from bituminous to anthracite. If a softened feed water be used, as it ought to be, there is therefore very little, it would seem, to choose between the two. In a station quick steam is a necessity, though we also want dry steam (this may be got in the future by the addition of superheaters to either type), and the author's opinion is that the cheapest and most useful battery of boilers will be found in the discreet combination of both types, as inaugurated by Mr. Gay, at Islington.

Both of the marine type are excellent, though personally for station practice, the author would prefer the dryback type, for the above-mentioned reason, viz., that the gases remain so much longer in contact with the boiler; and it, therefore, should be more efficient and economical. Both require very little floor space.

With all boilers great care should be observed in keeping the safety, 12 hours standing, say from 323 8° F. (the temperature of steam at 80 lbs.), to 352·5° F., the temperature at 125 lbs., after each lay-by, yet does not lose so much by radiation or absorption by brickwork, as a water-tube.

The amount of coal required per hour to keep the boiler No. 1, in the table, up to pressure when no steam was withdrawn, was 24 lbs. This is from a report by Prof. Kennedy and Mr. Bryan Donkin, which has been extracted from *Engineering*. The amount required to keep a water-tube boiler up to pressure under the same condition is about 35 lbs. per hour.

Feed Pumps.—It is well known that the usual donkey pumps are wasteful. The average ratio of steam required to drive the pumps to the feed water pumped is some 3 per cent. This is a serious item, and the following figures may go some way to accelerate the adoption of electrically-driven pumps for feeding station boilers; 100 lbs. of steam evaporated in a boiler may be accounted for thus:—

90 lbs. used in the engines.
10 lbs. condensed in the pipes, &c.

100

An engine working on a variable load, such as usually obtains, requires some 31 to 32 lbs. of steam per E.H.P. per hour.

Assume the boiler pressure to be 125 lbs.; then the pump has to deliver 100 lbs. against an equivalent load of (125 × 2·3) say, 288 feet, which means an expenditure of 28,800 foot-pounds; or, assuming the combined efficiency of an electrical motor pump to be only 0·6, and the steam dynamo 0·85, 1,298 watts, therefore $\frac{1298}{1706884} = \frac{x}{100}$, or the percentage of power required to feed the boiler by an electric pump is just 1 per cent., as against 3 per cent. where a donkey pump is used.

In direct current stations, with accumulators, it would be a great

advantage to be able to fill up boilers, say, on Sundays, without having to turn on steam; even if the feed pump pipes are taken directly from the boilers instead of from the range.

Of course it would be a distinct disadvantage, or even an impossibility in an alternating current station, unless designed on the Bolton or Croydon systems, with accumulators. But accumulators seem to be gaining ground in both types of station, and therefore the electrically driven pump could be almost generally adopted. Motor pumps are more costly initially, but this would seem to be the only objection.

The treatment of feed water requires more attention than is frequently given to it. The author knows of certain stations where very hard water is used, and is pumped cold unto the boilers. A boiler fluid is certainly periodically pumped in; but it will be agreed that the boiler is not the right place in which to precipitate the salts, and cold feed in these days should be out of the question.

First as to treating the water. The author has had two different water softeners in his charge; and in both cases the water (in one case 17½° and in the other 20½°) has been reduced to some 4° or 5° of hardness, and at a small cost; and with the further advantage that the plant takes up but little floor space. When it is remembered that $\frac{1}{16}$-inch scale means an increased consumption of coal of some 9 per cent., it will be seen how necessary this treatment is.

At Sunderland there is an evaporative condenser, and as the water is some 20½°, and contains a large proportion of the less easily reduced sulphates, the installation of it was the more necessary. The hot-well water is pumped through an oil extractor, and the make up feed water is obtained from the town main, undergoing treatment by the softener before use. This should be the best method for treating feed water, both for economy and scale reduction. Treatment of the water in the boiler is not at all satisfactory; partly because in some cases a heavy scum results which may cause over-heating, or, at any rate, priming, and, secondly, because the heating surface of the boiler must be reduced from the lodgment of the precipitate at the bottom of the boiler, where there is already a deficiency of heat in drum boiler; and it also means additional and more frequent cleaning. A complete water softening plant only costs about £0·18 per kilowatt installed.

Heating the feed water is again important, because every 10° rise in temperature results in a saving of 1 per cent. in fuel. In stations exhausting to atmosphere, of course the latent heat of the steam is partially given up through the medium of heaters to raise the feed water to a temperature of about 210° F.; or, in the case of Lancashire boiler, or similar type, an economiser is placed in the flue between the boilers and chimney in which temperatures of anything up to 350° may be obtained. A further advantage is obtained, viz., that the before-mentioned sulphates of lime or magnesia are rendered insoluble long before this temperature is reached, and are precipitated before entering the boiler.

FUEL.—Locality has a very great deal to do with the class of fuel adopted. In London, engineers are no doubt right (and have barely an alternative) in adopting Welsh coal, from its smokeless nature. But some of us have to burn duff or smudge, or at any rate bituminous coal; and then arises the question of hand-firing *versus* mechanical stokers, the better results with very small coal, such as slack or duff coal, are probably obtained with mechanical stokers; the firing must be little and often, or damping and caking results, and in hand-firing this means a large admission of cold air at each charge, which must affect the evaporation.

The excellent figures by Mr. Ellington, in his papers before the Institution of Civil Engineers and Mechanical Engineers, on "Hydraulic Power," taken from boilers fed by mechanical stokers, fed by coal conveyors, go to show the efficiency of this method of firing, and in cases, too, where there is a variable load, much the same as in an electricity station.

To a boiler in which Welsh coal has been burnt, and which, hand fired, had evaporated 7 lbs. per pound of coal, a mechanical stoker was fixed, and a bituminous slack used as fuel, when the evaporation of 8·98 lbs. water per pound of coal was obtained. The temperature of the feed was the same in both cases, and also the rate of firing.

It is surprising that forced draught is not more frequently adopted. Mr. Patchell has fixed an apparatus at the Maiden Lane station, and his excellent results were read before the Institution of Mechanical Engineers.

The closed ashpit system, with fans such as Fothergill's and others, give, of course, a far higher rate of combustion than with natural draught, and so with the steam jet system as fixed at Islington and other stations. The production of a larger indicated horse-power from the same boiler, which results from the adoption of forced draught, and the enormously increased evaporation when required, cannot fail to commend it.

This system, combined with a quick feeding mechanical stoker, should obviate any fear of smoke nuisance; the emission of black smoke being the disadvantage of forced draught when the fire is hand-fed.

Mr. Crompton has tried petroleum refuse, or astatki, at Kensington, and owing to the high calorific value of the fuel (as in all fuels containing a large proportion of hydrogen), and the comparatively small cost of the requisite fittings, it may prove a valuable adjunct to boiler equipments, to be used at least in an emergency.

STEAM PIPES.—Although perhaps foreign to the strict title of the paper, yet from the important item in the water and coal bill which is represented by the condensation losses in steam pipes, the author has ventured to include a few remarks about them. They are now completely duplicated in probably every station, and the present tendency is to adopt wrought-iron or mild steel, straight lengths, and solid drawn copper bends. In these latter steel flanges seem preferable, owing to their greater resistance to "cupping." The valves should preferably be of a sluice type, thereby giving a full bore to the pipe when open.

Bye-passes with cocks should be fitted to any valves larger than 5-inch bore, and are useful in keeping joints tight, by gradually warming up the laid-off pipes when required, and driving out any water that may accumulate therein, and in the prevention of water hammer. The author also considers it imperative, not only to thoroughly cover the pipes with non-conducting material, but also the flanges and stop valves. The condensation in a 6-inch steam pipe, uncovered, is 1·4 lb. per lineal foot per hour, and with a 2-inch covering 0·123 lb. at a temperature of 349·8° F., or a pressure of about 120 lbs., or less than one-tenth of the quantity given above.

As the flanges form effective gills, they radiate a great deal when left uncovered. An objection is that the flanges are not open to examination, and that leaky joints spoil the covering; leaky joints can be, and ought to be, averted, and now there are several means of covering the flanges with easily removable composition, in sections and otherwise.

The drainage of steam pipes is not always so well arranged as might be. From personal experience the author thinks in cases where there is a full bore throughout the whole range (by the adoption of sluice type valves), occasional drain pockets, with gauge glasses fitted, working on efficient steam traps (having a bye-pass direct to atmosphere for emergencies), the most effective system. There are steam traps and steam traps. Of four varieties with which the author has had to do, only one has been found to be reliable, and of value. No doubt members will have had their own experiences. There are some traps which will not only work well, but will deliver the condensation water against a head of some feet. This is often of great help in saving water by delivering direct to a feed tank, the drain traps being presumably at the lowest level, and the feed tank with a slight head on the feed pumps, the condensation water thus being used again.

CONCLUSION.

The author has not touched upon superheating, it having been thoroughly discussed at various meetings of the Institutions of Civil Engineers and Mechanical Engineers during the last 12 months. That this is certainly a source of economy in a station there can be no doubt; Edinburgh, for example, having given excellent results; and perhaps the Vice-president, Mr. Newington, will give us his opinion on this matter.

There is nothing probably in this paper of which all are not thoroughly cognisant, but the author hopes that in having had the honour of bringing it before you, a favourable opportunity may have arrived when this important question, which affects a figure of from 25 to 30 per cent. of our works' costs, may be discussed, and some of us obtain benefit by the experience of others in the various matters touched upon.

"THE GENERATION OF STEAM."* By J. J. STEISITZ, Borough Electrical Engineer, West Ham.

THE question of the generation of steam must be of considerable interest to all connected with this Association. A paper on such a subject must give rise to a discussion, and though the author is afraid he can present very little new or interesting matter to the meeting, he has no doubt when the discussion is finished good reasons will be advanced for generating steam entirely on one's own account, or combining with some other Corporation department, such as refuse destruction or sewage pumping, for using this type of boiler, or that type; or for various combinations.

Further, the questions of mechanical stoking, important when we think of trade disputes and the difficulty of getting good stokers, of water cleaners, of forced draught, and of economisers, feed heaters, and super-heaters, are all of paramount importance, and are well worthy of the attention of the borough electrical engineers of this country.

The efficiency and economy of the generation of steam are dependent on:—

1. The type of boiler.
2. The fuel.
3. The water.
4. The stoking arrangements.
5. Adjuncts to the boiler, such as economisers, feed heaters, superheaters, and forced draught.

The types most commonly in use in electric lighting stations in this country are:—

Lancashire boilers.
Tubular boilers of the Babcock & Wilcox type.
Marine type boilers.

All these are so well known that a description is unnecessary, but one or two of their characteristics are interesting.

In a correspondence the author had recently with a well-known firm, he was somewhat surprised to find them advise him not to have cross tubes fitted in the flues of Lancashire boilers. Even if the circulation is not increased much, and one naturally thinks it is, it seems that the flue by the insertion of these tubes is considerably strengthened.

The author cannot come across any evaporation tests of two Lancashire boilers, one fitted with cross tubes and one without, except when the boiler with tubes was new and the one without old. Naturally the new boiler with the tubes came out the better. The circulation of water in this type may not be so good as in the multi-tubular boiler, but there is no reason why a circulator should not be fitted, and the circulation, and consequently the efficiency, increased. Such a fitting is used at the present time for cleaning purposes. Whether or not it is a success as a cleaner I do not know, but from experiments witnessed, the circulation was certainly improved.

Good circulation is the salvation of a boiler. It is governed to some extent by the working pressure, consequently the water-tube type has had the advantage. With bad circulation there is a loss of economy due to an increased temperature of the heating surfaces, which leads to the rapid deterioration of the boiler.

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* Read at Manchester, June 30th, 1897.

The question of the pressure at which a Lancashire boiler may be worked is of importance, and it is noteworthy that quite recently one large firm, builders of this type, advised the use of tubular boilers for all pressures over 120 lbs.

As regards the life of this boiler, so much depends on the nature of the feed water used and the care taken in cleaning, &c., that any stated time might be misleading. With good water and ordinary care, the average life of this type is about 20 years, without any reduction in the working pressure being called for or necessary.

With tubular boilers of the Babcock & Wilcox type, the pressure can be raised considerably above that usually raised in Lancashire boilers. As to the life it can hardly be given, as a few tubes will at any time make it practically as good as new. The repairs and maintenance of this boiler will in most cases be considerably in excess of the amount spent on a Lancashire boiler. Cleaning is a longer job, and the chances of trouble or an accident from a defective joint are considerably increased as between the 70 or 80 joints on a Babcock and Wilcox, and the one or two joints on a Lancashire boiler.

The circulation is very good, and the evaporation per pound of fuel consumed very high; in fact, I think the highest ever obtained, except by the Thorneycroft boiler as used on some of the torpedo boats built by that firm. The boiler takes up little room for the work it does, though it must be remembered that a distance for drawing the tubes should be debited to the account of the space allowed for it. Many conflicting statements have been made in favour of and against the Babcock & Wilcox boiler for intermittent use. The majority of boilers in an electric light station are thus used, so this point is of considerable interest to us.

That there is more loss in cooling down in a Babcock & Wilcox than from a Lancashire boiler the author thinks is true, owing to the large radiating surface of brickwork enclosing the former. This, however, may be more than compensated for by the ease with which steam is raised in the former.

The marine boiler has proved an unqualified success wherever it has been adopted. The average life would be rather less than the Lancashire boiler, owing to the difficulty in cleaning it. Many are the efforts made by engineers to stop either pitting or scale forming on the tubes and plates. One arrangement struck the author as being rather neat, at least in theory. It was described by Mr. Dolby at the Institution of Civil Engineers some years ago.

A small alternating machine was driven by a strap from the propeller shaft. From one terminal a wire was carried through the shell of the boiler, but insulated from it, and was fastened to two rods at a point above the water line. The rods were bolted to two plates about the centre of the height of the water. The plates were kept in position by clamps insulated from the shell of the boiler. The other terminal of the machine was connected to earth. The effect of the current was to electrolyse a small part of the water, the hydrogen would follow the course of the current and be deposited on the shell of the boiler and the flue tubes. When the current changed, oxygen would be produced. The two would combine and produce a thin film of chemically pure water, which would hinder the deposit upon the shell and tubes.

Another plan the author has seen adopted at sea is to give the inside of the boiler a good coating of coal tar. He has known this tried on boilers on land with the result that, instead of cleaning the boilers every three weeks, every eight weeks was quite sufficient.

Many engineers hold that it is as important that the products of combustion in their course to the shaft should be brought into contact with all the heating surface, as that there should be the good circulation of water. Should this be so, no boiler he is acquainted with fulfils the conditions better than one of the ordinary marine type.

Fuel.

The theoretical value of various fuels can be found in many pocket-books; these the author does not intend to touch on. All he can say is, that one must be guided by the locality in which the steam has to be generated, and that controls the cost; the bye-laws of the town with reference to smoke nuisance, and the stoking arrangements employed. If in the centre of a town, the bye-laws will probably make it a necessity to use mechanical stokers and cheap coal, or the best Welsh coal and ordinary hand firing, and perhaps if the town is far from any coal fields, nothing better or more economical than the latter is to be had.

Feed Water.

In all cases, and whatever boiler may be in use, it is undoubtedly necessary to have good water. In many districts the water has to be treated, and it most certainly pays the user of steam to have this treatment effected outside the boiler. Boiler compositions may be good; they may also do more damage to the boilers than good to the water, but whatever is done to the water, the author's point is that it should be done outside the boiler. He does not intend to touch on the many water cleaners, softeners, &c., in the market, but there are some which will be found to do all that is necessary with very little initial outlay, small maintenance, and practically no trouble. If surface condensers are used a certain amount of oil will get into the water, and if not dealt with carefully will most probably play havoc with the boiler. This will be the result with all boilers, though probably an accident would be more likely to happen with a boiler of the tubular type. A coke filter used intelligently will be found to be all that is required. The author understands from Mr. Proctor, of Bristol, that he has adopted an ordinary cream separator to deal with his condensed water.

Stoking Arrangements.

We now come to one of the most interesting considerations in connection with the generation of steam. The main question at first is hand-firing *v.* mechanical stoking, but after one has made up one's mind to the advantages of the latter system, which with the exception of a few special cases is inevitable, one is met with the question of coking *v.* sprinkling stokers.

As all electricity works are growing concerns, we need hardly go into the question of whether mechanical stokers are advantageous where only one or two boilers are in use, as all our works must have ere long large batteries of boilers. The advantages accruing from the use of mechanical stokers are:—Immunity from creating a smoke nuisance; this is not of vital importance to us all at present, but the time must come shortly when the public will have recognised that the creation of smoke is not a necessity, and will insist on the nuisance being abated. By that time mechanical stokers will probably be adopted as an easy and economical way out of the difficulty. That a smoke nuisance may be avoided by very careful hand firing, and the use of the best coal, is admitted; but it is almost impossible to get three shifts of careful stokers, and almost as difficult to get an engineer to continue buying the best coals if he can struggle through (with perhaps an occasional summons) on an inferior quality; while with mechanical stokers the commonest slack can be used with advantage, with no prospect of trouble, and there will be a large reduction in the coal bill.

The reason for the economy of fuel is partly due to the fire being always clear. Again, not only do you get better results from your boilers, but the economiser is more efficient, and the flue gases do not carry so much smoke with them, so that greatest heat is obtained in the furnace. That economy in fuel does really exist is best brought to your notice by quoting the following tests:—

Hand-Firing *v.* Mechanical Stoking.

Duration of trial	10 hours.	10 hours.
Description of fuel used ...	Small slack.	Small slack.
Price of fuel used	About 6s. per ton.	About 6s. per ton.
Fuel consumed per hour ...	492·8 lbs.	588 lbs.
Water evaporated per hour ...	415 gallons.	624 gallons.
Temperature of feed water ...	70° F.	70° F.
Steam pressure	50 lbs.	50 lbs.
Water evaporating per pound of fuel from and at 212° F.	9·87 lbs.	12·43 lbs.
Cost of evaporating 500 galls.	1/4·2	1/0·9.

With a mechanical stoker and conveyer properly arranged, one man can attend to the firing of five boilers, and with furnaces each; with hand-firing it is almost impossible to get more than four furnaces attended to by the very best of stokers.

The saving, therefore, in stoking five boilers mechanically would be:—Three men's wages against seven men's—a saving of £6 per week.

Against this there is the cost of working the mechanical stoker, 3s. per week; the interest and sinking fund on the outlay 17s. 10d. per week; and the repairs and maintenance of the stokers, 13s. 5d. per week, or a saving of £4 5s. 9d. per week, independently of any saving by the use of cheaper fuel.

The difference between Vicar's, which is a good example of the coking stoker, and the Bennis, which is a good example of the sprinkling stoker, lies in the fact that the former machine pushes the coal on at the front end of the fire grate, and gradually carries the fuel to the back end; there is, therefore, a great mass of incandescent fuel at the front, the fire gradually tapering down to nothing at the back end; in the latter the fire is kept level, as it ought to be in hand firing, and the coke thrown on in small quantities, each time in a different place, thus approximating as nearly as possible to perfect hand firing.

With the former machine the boilers cannot be forced rapidly; with the latter machine the amount of coal burned can be adjusted from 15 lbs. to 50 lbs. per square foot of grate per hour, thus giving the necessary margin to meet sudden demands of steam. From this point of view alone borough electrical engineers must look with favour on a good sprinkling stoker.

Further, the following test—there are many others of a similar nature—may assist one in making up one's mind as to the advisability of adopting a coking or a sprinkling stoker:—

	Coking stoker (Vicars).	Sprinkling stoker (Bennis).
Duration of trial	120 hours.	120 hours.
Description of fuel used ...	Small slack.	Small slack.
Price of fuel used	About 4s. per ton at pit.	About 4s. per ton at pit.
Fuel consumed per hour ...	708 lbs.	885 lbs.
Temperature in flue (average)...	680° F.	831° F.
Temperature of feed water ...	161° F.	161° F.
Steam pressure	80 lbs.	80 lbs.
Water evaporated per hour ...	4,372 lbs.	6,916 lbs.
Water evaporated per pound of fuel from and at 212° F.	6·72 lbs.	8·48 lbs.

It is interesting in connection with these tests to notice that at the Leeds Electricity Works, where the record, according to *Lightning*, is held for the lowest cost of coal per unit sold, sprinkling stokers are used.

Economisers.

Probably of all the adjuncts to a boiler none is more used or better known than the economiser; the author thinks he is right in saying that there is hardly an electric lighting station in the Kingdom where an economiser has not been installed.

The economiser, consisting as it does of a bundle of tubes placed in the flue leading from the boiler to the chimney, is simplicity itself.

Fitted as they generally are with mechanical cleaners, the maintenance is very small, the repairs are, or ought to be, few—in fact, except for its very apparent advantages, it might be installed, set to work, and then be completely forgotten. The only point to be taken into consideration before installing an economiser is the question of the temperature of the flue gases. Should the temperature of the gases leaving the boiler be not more than 400° F. (but as a rule they are nearer 600° F.) an economiser would be practically useless. The economy due to the use of a good economiser may be put down at from 10 to 15 per cent. of the fuel burned according to the temperature of the gases escaping from the furnaces. About the only precaution to take is not to pump cold water through the economiser, otherwise there is a risk of excessive external corrosion. This is a trifling point though, and easily got over by running the exhaust of one of the auxiliary engines in the feed water tank.

Where no arrangements for condensing are made, an economical way of heating the feed water is by passing it through some form of exhaust feed heater. Considerable economy is experienced, the feed water being raised to about 200° F. when a fair load is on the engines. A heater has also the advantage of acting as a purifier.

SUPERHEATING.

While superheaters may be classed as adjuncts to the boiler, the economies (with an exception in the case of the MacPhail superheater), are noticed in the engine. The advantage to the boiler is, that its duty is lightened. The paper on this subject by Mr. Patchell, together with the discussion on it, read before the Institution of Mechanical Engineers, is probably fresh in the memory of all.

From it we may gather the advantages of superheating are very real, and that the superheater has come, and come to stay.

The few difficulties in the way of their general adoption are being rapidly overcome. Knowing as we do that a small degree of superheat only slightly in excess of that in saturated steam produces a disproportionately large beneficial effect, there ought to be some good reason for superheaters not being more generally adopted.

In 1870, when superheating was practically dropped, the reasons were apparent. At that time they had no suitable lubricant, and large superheaters placed as they generally were in the uptake of the flue, were liable to become overheated and become a source of danger. Both these difficulties have been got over now, and the author is inclined to agree with the writer who attributed the non-adoption of superheaters to the fact that "the design of engines had been so cut, that any step in the direction of the almost unknown was useless and unprofitable."

FORCED DRAUGHT.

In studying the economical generation of steam the effect of forced draught must not be neglected.

In most cases one hears of enormous savings in boilers under forced draught against those without, but one never hears of any debit for inducing this draught. Steam, say at 120 lbs. pressure (the author is now talking of forced draughts induced by steam jets), wastes away at a wonderful rate through the very small orifices in use. No doubt some member will be able to give some information on this point.

In dealing with the smoke question, forced draught will undoubtedly be worth very careful consideration, and in suitable places where coal and coke dust can be obtained at a nominal price, be simply invaluable. In fact the use of this fuel is impossible without a forced draught.

To station engineers with the present unsatisfactory load curves, the question of the adoption of the forced draught is particularly interesting. Very large demands for steam are made for a very short portion of the 24 hours.

It will therefore be generally found desirable to keep the number of boilers down and force them for the short period referred to, even if at that time one does not get the full duty from the fuel burned.

One of the best means of adopting forced draught is to have a fan forcing air into the stoke-hold and leaving the only passage out through the furnaces. This plan has been adopted in many boats, and there is no reason why some modification might not be adopted in our boiler houses on land.

The author would like to raise the question of the advisability of joining with some other corporation department for the generation of steam; combinations of dust destructors and electric lighting plants have been, and are being, erected; with what measure of success he is hardly prepared to say. At Oldham the combination seems to work well, and Mr. Newington, the Borough electrical engineer, informs the author that they are at the present time saving about 5 tons of fuel per week. At Leicester, too, destructors of six cells each are at work. The steam available in one case is used to generate electricity for lighting the destructor buildings—while the other supplies the engine of a small factory.

At West Ham the author has joined with the borough engineer, who is erecting a large sewage pumping station, in having a joint boiler-house. As he will always have to be prepared to put his storm water pumps into action, and will consequently have boilers for that purpose under steam, it may fairly be expected that the electricity department will have very little to pay for the generation of steam during the greater part of each day throughout each year.

It may be of interest to you to know the temporary arrangements we are now making for generating steam before the boiler-house and shaft are complete. We have laid down two boilers (out of nine) farthest away from the shaft. These two boilers are fixed permanently. Where the main flue is to be continued a damper is put in. At the end of the flue a small engine and fan and wrought-iron shaft are erected. If this arrangement is to be used for some time, we shall heat the air in tubes at the back end of the boiler, and then pass it through the fire through the fan to the iron shaft. We shall thus get a good draught, no smoke, and the total cost of the temporary arrangement will be only some £400. The building of the main flue and shaft can be continued, and when all is complete the damper can be withdrawn, and the engine and fan and the iron shaft removed.

In connection with this the following test made by Messrs. Allen, Son & Co., of Bedford, to whom the author is indebted for showing him a similar plant at their works, is of interest.

TEST.

Babcock & Wilcox's boilers.

Induced draught, with arrangement for heating air supplied to furnaces by means of waste gases.

DURATION OF EXPERIMENT.—Fire lit at 3.15 p.m., Wednesday, November 25th, 1896. Fires drawn at 2 p.m., Saturday, November 28th, 1896. Actual number of working hours, 32¾.

COAL USED.—Waynes's Merthyr.

All the coal used included in the following results, viz.:—The coal used in getting up steam and banking fires on Wednesday, Thursday and Friday nights, is included with that actually used for steam purposes.

FEED WATER.—Feed water heated from 49° F. to an average temperature during experiment of 137·2° F. by exhaust steam from fan engine. Kennedy's water meter used.

Mean pressure of steam during experiment, 176·3 lbs. above atmosphere.

Water evaporated per pound of coal at 176·3 above atmosphere	= 9·64 lbs.
Water evaporated per pound of coal from and at 212° F.	= 10·91 „
Percentage of ash	12·5 per cent.
Water evaporated per pound of combustible matter at 176·3 lbs. above atmosphere	= 11 lbs.
Average temperature of escaping gases in fan chamber	= 378° F.
Average temperature of atmosphere in stokehole	= 57·9° F.
Average temperature of air supplied to furnaces	= 157° F.
The ash-pit doors were kept closed except while removing ashes.	
Average vacuum above fire-bars as measured in fan chamber	= 1·95″ water.

In conclusion, the author feels an apology is necessary for not presenting data on the various points raised. As an excuse, he may remind members that at present he is an engineer without a station, and with no boilers to experiment on. At some future date he may be able to bring forward information which may be of interest to the Association, as to the best and most economical method of generating steam, and which will set at rest, if no other, at least his own many doubts that have grown as he prepared this paper.

MORE ABOUT MOTOR CARS.

TECHNICAL Journals interesting themselves in new departures are exceedingly apt to become offensively partisan. No. 9 of Vol. I. of the *Automotor* illustrates this. So blinded are they in their rage at the more or less deserved strictures of the *Engineer* and *Engineering* that we also are accused of having not a good word to say for motor cars. We did not agree with the *Engineer's* condemnation, but went so far as to state that the benzine motor car was a success and our young critic prints this and says we have not a good word to say. Whereas as a fact we had a good deal to say and said it against the sweeping assertion of the *Engineer* that there was no motor car industry. The *Engineer* seemed compelled to much protest to cover the withdrawal of the £1,100. When it begins to ask questions of the *tu quoque* order the *Automotor* gets into better ground. Here are a few *apropos* of the perfection and simplicity of things other than motor cars, to wit, of a Webb compound locomotive fitted with Joy gear; the freedom of a locomotive from smell; the offensiveness of the horse. Is a locomotive free from vibration? Does it set fire at times to hayricks? or does it jump the track? Do we ostracise the locomotive because it is so far from perfect? By no means, because it is so convenient, nor need we damn the motor car. The *Engineer* is condemned as illogical because it argues there is no industry simply because there was no competition. The *Engineer* "made a wilderness and called it peace" is in fact a simile that the *Automotor* might have used. It is stated that so far from the contention being true, there are at least a score of firms working at the problem of trade vehicles, and three firms at least have evolved practical trade vehicles, namely, Thorneycrofts, Atkinson & Philipson, and the Liquid Fuel Co., nor are these firms of the company promoters' get up—made to sell. To demand a thoroughly satisfactory motor vehicle so early is really too narrow minded, and though doubtless the *Engineer* is quite satisfied at the decision of Sir F. Bramwell and his colleagues, others are not.

About a page of letters appear in the *Engineer* of June 18th. The best of these is from Simpson & Bodman of Didsbury, Manchester. These gentlemen are working out a vehicle or trying to do so, and the basis of their endeavour is stated to be: "(*a*) The vehicle must fill a want, and must, in its sphere of work be more useful and economical than horse or rail. (*b*) The size and appearance must not be any material departure from existing types, and the suspension must be correct. (*c*) The tare weight must bear as nearly the present relation to load as possible, as it affects (*a*). (*d*) The speed must be absolutely variable from zero to full speed, not progressing in jerks. The general regulation must be absolutely automatic, not only not dependent on the control of the driver, but, when running, practically outside him

altogether. (*e*) The car must be at least as quiet in its progression as an ordinary van, if not quieter. (*f*) The power that we decided on was 10 indicated horse-power for the first ton, and 5 indicated horse-power per ton after, gross weights."

Now we are inclined to think that the requirement (*b*) is a little strained. A couple of horses will weigh 2 tons. Is it not possible to have a motor vehicle something longer than a horse vehicle, say half a horse length in addition; and as to (*c*) Is it not fair that something of the weight of the horses should be allowed the engineer. The writers of the letter are convinced that a paying van or lorry can be made, but it will not be propelled by gasoline, nor yet by petroleum, nor by petroleum generated steam. The cost of gasoline power is 2d. per wheel rim-horse-power hour, as per the Chicago trials. Solid fuel power should not cost above $\frac{3}{10}$d. per H.P. hour. The writers evidently believe in solid fuel — we suppose coke. It appears to them difficult to design a vehicle that will carry a load of double its own weight, hence the absurdity of the existing law which makes it almost impossible to design a vehicle to carry an ordinary Manchester load of four tons.

A Serpollet generator will only raise 3½ lbs. of steam per lb. of fuel, a poor showing, and it is not thought that this generator will serve for trade purposes by reason of such poor efficiency.

Referring to the *Engineer's* prompt denunciation of the heavy oil motor, Mr. J. H. Knight points out that it is only a few years ago that the paraffin lamp was an odious smelling thing unfit for a room. Yet now we all know that these lamps are used in preference to gas or any other illuminant, save electricity, by reason of their greater cleanliness and absence of smell. Plants that die in a gas lighted room live with oil lamps. Mr. Knight believes the oil engine will eventually be made odourless, while the Yeovil Motor Car Company write to contradict the impression that their non-smelling car used benzine. It did not, but contained a heavy oil motor. This company further state that they did a very good business at the Crystal Palace. A "Practical Engineer" thinks the successful oil motor must differ widely from anything so far made, and rather unkindly asks Mr. Sturmey, as chairman of the Daimler Company and director of the Great Horseless Carriage Company to prove the *Engineer* wrong. This is a little rough on Mr. Sturmey. Does "Practical Engineer" think for a moment that Mr. Lawson and his *confréres* allowed their promotions to be so overloaded with working capital as to be able to find money to experiment with. Why need to experiment when valuable master patents are possessed by them.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. THOMPSON & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

14,378. "Improved mode of securing pipes in sockets." ELIAB BOX. Dated June 14th.

14,395. "An improved automatic time meter for telephonic conversations." M. BÖSL. Dated June 14th.

14,397. "Improvements in the generation and utilisation of hydrogen gas and electricity for motive power lighting and heating purposes." L. H. WATTLES. Dated June 14th.

14,421. "Improved apparatus for supplying or measuring a current of electricity." W. D. WATSON and T. HUMPHREYS. Dated June 15th.

14,432. "Improvements in electrical cable suspenders. J. FINCHAM. Dated June 15th.

14,439. "Improvements in the manufacture or production of an insulating material and the application thereof to the insulation of electrical conductors. H. EDMUNDS. Dated June 15th.

14,456. "Improvements in electrical pushes and contacts therefor." M. BYNG and V. HOLT. Dated June 15th.

14,457. "Improvements in dynamos and in electrical distribution of mechanical and other power." R. WOOD. Dated June 15th.

14,475. "Improvements in systems of distribution of electricity." THE BRITISH THOMSON-HOUSTON COMPANY, LTD. (E. W. Rice, Junior, United States.) Dated June 15th. (*Complete.*)

14,476. "Improvements in insulators for electric conductor rails and feeders." THE BRITISH THOMSON-HOUSTON COMPANY, LTD. (Sam H. Libby, United States). Dated June 15th. (*Complete.*)

14,477. "Improvements in and relating to insulators for electric conductor rails." THE BRITISH THOMSON-HOUSTON COMPANY, LTD. (S. H. Libby, United States). Dated June 15th. (*Complete.*)

14,478. "Improvements in electric meter apparatus. E. OXLEY. Dated June 15th. (*Complete.*)

14,506 "Improvements in telephone systems and in apparatus for use therein." C. C. GOULD. Dated June 15th. (*Complete*).

14,508. "Improvements in primary batteries or cells." I. KITSEE. Dated June 15th. (*Complete.*)

14,520. "Improvements in and relating to electric and other auto-cars." H. H. LEIGH. (Société Charles Milde, fils et Compagnie Robert, Mandos, and Auguste Courtant, France). Dated June 15th. (*Complete*).

14,524. "Improvements in electric brushes and the like." J. O. FOWLER. (Date applied for under-patents, &c., Act 1883, Sec. 103, November 16th, 1896, being date of application in the United States). Dated June 15th.

14,526. "Regulator to be affixed to the wire supporting pendant incandescent electric lamp for raising or lowering lamp." J. W. G. PALMER. Dated June 15th.

14,568. "An improved method of changing illuminating or advertising electrically lighted devices. E. L. O'BRIEN and L. GRANT. Dated June 15th.

14,605. "Improvements in means for electrically indicating when a ship reaches a given degree of roll." G. H. ZEAL. Dated June 16th.

14,629. "A regulating ring for electric stop motions on drawing frames used in cotton spinning." M. T. MAKIN. Dated June 17th.

14,659. "Improvements in and relating to the counting and recording of the number of messages transmitted over telephonic or other signalling circuits." D. SINCLAIR and W. J. GREY. Dated June 17th.

14,673. "Improvements in electrically operated engraving tools." M. BYNG and H. BURGE. Dated June 17th.

14,679. "Improvements in electrical conductors." W. JUDD. Dated June 17th.

14,694. "Improvements in portable electric primary batteries." C. H. COLE. Dated June 17th.

14,708. "Improvements in apparatus for coating metal articles by electro-deposition." G. H. NASH. Dated June 17th.

14,709. "Improvements in apparatus for coating metal articles by electro-deposition." G. H. NASH. Dated 17th.

14,741. "A new or improved electric alarm apparatus." G. H. SKEE. Dated June 18th.

14,743. "An improvement in telephone transmitters." J. WADE. Dated June 18th.

14,804. "Improved construction of electric alternating current generators." O. T. BLATHY. Dated June 18th. (*Complete.*)

14,811. "A new or improved telephone holder." H. KANN. Dated June 18th.

14,848. "An improved autc-copying telegraph." A. C. BROWN, G. R. NEILSON and R. BURN. Dated June 19th.

14,910. "Improvements in electric motors for driving motor carriages, winches, and stationary machinery, also as a portable motor for rotary hair and cleaning brushes for drilling, milling, and other purposes." H. W. HEADLAND. Dated June 19th.

14,923. "Improvements in alternate current motors." A. SOAMES. Dated June 19th.

14,924. "Improvements in telegraphy." M. J. P. O'GORMAM. Dated June 19th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps*).]

1896.

21,548. "Improvements in and connected with apparatus for punching strips of paper and like material, suitable for use in telegraph transmitters, and for like purposes. C. L. BUCKINGHAM. Dated Sept. 29th. Relates to perforating apparatus designed to perforate paper or other material by means of a series of punches operated in different combinations or numbers, or are differently disposed with relation to one another in the different groups. 50 claims.

23,663. "New and useful improvements in the apparatus for the production of oxygen and hydrogen by electrolysis." P. GARUTI and R. POMPILI. Dated Oct. 24th. Relates to an improvement on 16,588 of 1892 and consists in the use of metallic diaphragms of a suitable resistance perforated in their lower part by a number of holes. 1 claim.

24,223. "Improvements in electric switches." I. H. STOREY, H. L. STOREY, and J. PARKINSON. Dated October 30th. The switch arms or slides are mounted on opposite sides of an axle capable of oscillation, the switch arms being adjustable in the lengthway of the oscillating axle to come opposite and to make and break contact when the axle is oscillated, with any desired dynamo. 1 claim.

25,903. "Improvements in controlling electric arcs." THE BRITISH THOMSON-HOUSTON CO., LTD. (Elihu Thomson). Dated November 17th. The improvement relates to the art of regulating electric arcs, which consists in subjecting the arc to the directive influence of a resultant field of force produced by a plurality of magnetic or electro-magnetic devices, the lines of force from some of which tend to drive the arcs in one direction, while those from the other devices act to oppose or modify the action of the first named. 5 claims.

29,685. "Improvements in apparatus for signalling by daylight, especially adapted for ships' use." J. C. CHAPMAN. (General Electric Co.) Dated December 24th. Relates to a system of day signalling wherein are combined two or more independently movable shapes, separate electromotive devices for moving such shapes independently. The shapes are moved in accordance with a preconcerted code, by means of a manually operated keyboard connected to a source of electrical energy. 12 claims.

29,907. "Improvements in the manufacture and production of elements or plates for electrical storage batteries." C. BRAULT. Dated December 29th. Relates to the manufacture and production of electric storage battery plates by compressing between the parts of conductive grids active material, or material to be rendered active prepared from a mixture of oxide of lead or litharge and sulphate of an alkali or of an alkaline earth treated with a solution of ammonia, or of ammonical salt (with or without bisulphate of mercury according to the denomination of the plate). 3 claims.